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CHIEF OF SPACE OPERATIONS

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Safety

RANGE SAFETY USER REQUIREMENTS MANUAL VOLUME 6 – GROUND AND LAUNCH PERSONNEL, EQUIPMENT, SYSTEMS, AND MATERIAL OPERATIONS SAFETY REQUIREMENTS

COMPLIANCE WITH THIS PUBLICATION IS MANDATORY

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This manual implements Department of Defense Directive (DoDD) 3100.10, *Space Policy*; DoDD 3200.11, *Major Range and Test Facility Base*; DoDD 3230.3, *DoD Support for Commercial Space Activities*; Air Force Policy Directive (AFPD) 91-1, *Nuclear Weapons and Systems Surety*; AFPD 91-2, *Safety Programs*; AFPD 63-1, *Integrated Life Cycle Management*; Air Force Instruction (AFI) 91-202, *The US Air Force Mishap Prevention Program*, and the *Memorandum of Agreement between the Department of the Air Force and the Federal Aviation Administration on Safety for Space Transportation and Range Activities*. This volume contains information previously found in Eastern and Western Range 127-1, Chapter 6, *Ground Personnel, Equipment, Systems, and Material Operations Safety Requirements*. It contains safety requirements for ground and launch support personnel and equipment, systems, and material operations on United States Space Force (USSF) ranges, including the Eastern Range (ER) at Cape Canaveral Air Force Station (CCAFS) and the Western Range (WR) at Vandenberg Air Force Base (VAFB). The following major topics are addressed: Range User responsibilities; ground operations policies; documentation

requirements; ground operations general requirements; material handling equipment, crane and hoist, personnel platform, powered industrial truck, and elevator operations; acoustic hazard operations; non-ionizing radiation operations; radioactive (ionizing radiation) sources operations; hazardous materials operations; ground support and flight hardware pressure systems operations; ordnance operations; electrical systems operations; motor vehicle operations; convoy operations; launch operations; and solid rocket motor and motor segment operations.

This volume applies to all Range Users conducting or supporting operations on USSF ranges. Range Users include any individual or organization that conducts or supports any activity on resources (land, sea, or air) owned or controlled by USSF ranges. This includes such organizations as the Department of Defense (DoD), United States (US) government agencies, civilian launch operators, and foreign government agencies and other foreign entities that use USSF range facilities and test equipment; conduct prelaunch and launch operations, including payloads to orbital insertion or impact; and/or require on-orbit or other related support. Commercial users intending to provide launch services from one of the ranges shall have a license or license application in process from the Department of Transportation's Federal Aviation Administration (FAA) or have a DoD sponsorship and be accepted by the DoD to use the ER or WR. Foreign government organizations or other foreign entities shall be sponsored by an appropriate US government organization or be a customer of a Range User. This volume applies to the Air National Guard. It does not apply to the Air Force Reserve Command.

In accordance with AFSPC Instruction (AFSPCI) 91-701, *Launch and Range Safety Program Policy and Requirements*, all tailored versions of AFSPC Manual (AFSPCMAN) 91-710 affecting public safety are approved by the Space Wing Commander or his/her delegate. The authorities to waive wing/unit level requirements in this publication are hereby identified as Tier 3 (“T-3”). See the AFSPC supplement to AFI 33-360, *Publications and Forms Management*, for a description of the authorities associated with the Tier numbers. Submit waivers through the chain of command to the appropriate Tier waiver approval authority through publication Office of Primary Responsibility (OPR). Ensure all records created as a result of the processes prescribed in this publication are maintained in accordance with (IAW) Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of IAW Air Force Records Information System (AFRIMS) Records Disposition Schedule (RDS). Refer recommended changes and questions about this publication to the OPR using the AF Form 847, *Recommendation for Change of Publication*; route AF Forms 847 from the field through the appropriate functional chain of command.

This publication may be supplemented at any level, but all supplements must be approved by HQ USSF Directorate of Safety (HQ USSF/SE), the OPR of this publication, prior to certification and approval. Each Wing may incorporate unique requirements into documents other than a supplement, such as an operating instruction, which is only required to be coordinated internally within the local wing/base organization structure and approved at the local level.

Note: AFSPCMAN 91-710 Volume 1 includes a complete table of contents for all the volumes of AFSPCMAN 91-710. In addition, each individual volume contains its own table of contents. SPFCMAN 91-710 Volume 7 contains a glossary of references, acronyms and abbreviations, and terms for use with all the volumes. Special publication formatting features are described in 1.2 of this volume.

SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. In accordance with AFI 33-360, **Attachment 1** has been added to reflect SPFCMAN 91-710 Volume 7 contains the references, prescribed forms, and adopted forms.

SUMMARY OF CORRECTIVE ACTIONS

The heading has been updated with the correct control number SPFCMAN91-710V6. No content has been changed.

Chapter 1

INTRODUCTION

1.1. General.

1.1.1. All Range Users operating on USSF ranges are subject to the requirements of this volume to ensure that pre-launch, launch, and reentry (to include reusable launch vehicles) operations are conducted safely. Air Force occupational safety and health standards do not apply to contractors or contractor employees except where specifically required by the contract or use agreement.

1.1.2. When government and third party personnel, government resources, and/or shared resources with commercial entities are not involved or exposed to hazards from an operation, or when Range User activities are contained within the boundary of their operations space and do not impact areas outside of their control, deviation from these requirements through the tailoring process is permitted. Range Users are encouraged to tailor this manual to focus requirements on their unique situation.

1.2. Organization of the Volume.

1.2.1. Main Chapters. The main chapters of this volume include common requirements for all vehicle classes. Appendices include additional requirements to supplement the main chapters.

1.2.2. Open Text. The open text contains the actual mandatory performance-based requirements. Tailoring expected for these requirements would be either the deletion of non-applicable requirements or a change to an existing requirement due to a different design or process with rationale acceptable to Wing Safety. For example, solid rocket motor performance requirements would be deleted for launch systems that do not use solid rocket motors.

1.2.3. Bordered Paragraphs.

1.2.3.1. Bordered paragraphs or text boxes, identified as tables and notes in this document, are non-mandatory and are used to identify some of the potential detailed technical solutions that meet the performance requirements. In addition, they may be used to provide lessons learned from previous applications of the performance requirement, where a certain design may have been found successful, or have been tried and failed to meet the requirement. These bordered paragraphs are provided for the following reasons:

1.2.3.1.1. To aid the tailoring process between Wing Safety and Range Users in evaluating a potential system against all the performance requirements.

1.2.3.1.2. To aid Wing Safety and Range Users in implementing lessons learned.

1.2.3.1.3. To provide benchmarks that demonstrate what Wing Safety considers an acceptable technical solution/implementation of the performance requirement and to help convey the level of safety the performance requirement is intended to achieve.

1.2.3.2. The technical solutions in the bordered paragraphs may be adopted into the tailored version of the requirements for a specific program when the Range User intends to use that solution to meet the performance requirement. At this point, they become mandatory requirements to obtain Wing Safety approval. This process is done to:

1.2.3.2.1. Provide an appropriate level of detail necessary for contractual efforts and to promote efficiency in the design process.

1.2.3.2.2. Avoid contractual misunderstandings that experience has shown often occur if an appropriate level of detail is not agreed to. The level of detail in the bordered paragraphs is necessary to avoid costly out-of-scope contractual changes and to prevent inadvertently overlooking a critical technical requirement.

1.2.3.3. The Range User always has the option to propose alternatives to the bordered paragraph solutions. Range User proposed solutions shall be evaluated against requirements in this manual. Alternative solutions other than those offered in bordered paragraphs shall demonstrate an equivalent level of safety, after which time they become part of the tailored AFSPCMAN 91-710 for that specific program.

1.2.3.4. Wing Safety has final decision authority in determining whether Range User proposed detailed technical solutions meet AFSPCMAN 91-710 performance requirements.

1.3. Compliance Documents. Code of Federal Regulations (CFR) for the Occupational Safety and Health Administration (OSHA) (29 CFR), Environmental Protection Agency (EPA) (40 CFR), Department of Transportation (DOT) (49 CFR), as well as Air Force Instructions (AFIs), and industry standards are specified as compliance documents throughout this volume. When there is a conflict between federal regulations, industry standards, and other requirements, the more stringent requirement shall be used.

Chapter 2

RESPONSIBILITIES AND AUTHORITIES

2.1. Wing Safety, 30th and 45th Space Wings. Unless otherwise noted, all references to "Wing Safety" in this volume refer to the Wing Safety organizations of the 30th and 45th Space Wings. Wing Safety is also commonly referred to as Range Safety. Specific responsibilities of Wing Safety include the following:

2.1.1. Review and approval of the following:

2.1.1.1. Operations Safety Plans (OSPs).

2.1.1.2. Ground Operations Plans (GOPs).

2.1.1.3. Danger Area Information Plans (DAIPs).

2.1.1.4. Facility Emergency Operating Plans (FEOPs) other than those limited to complex safety.

2.1.1.5. Other documents as specified in this document.

2.1.1.6. During the review and approval process, both Wing Safety and the Range User shall assure timely coordination with other Wing agencies as appropriate. Other Wing agencies include, but are not limited to, Pad Safety, Medical, Civil Engineering, and the Fire Department.

2.1.2. General.

2.1.2.1. Ensuring that hazardous and safety critical facilities are periodically inspected as required.

2.1.2.2. Monitoring hazardous and safety critical operations.

2.1.2.3. Defining the threat envelopes of all hazardous operations that may affect public safety or launch base safety and establishing safety clearance zones.

2.1.3. Pad Safety. Although the following are not Range User requirements, it is intended that the Range User be familiar with some of the key responsibilities of the Pad Safety function as they relate to the Range User's safety requirements since interactions between the two will be required. **Note**: In the current organizational construct, Pad Safety functions are performed by government personnel in the 30 SW Wing Safety Office, and by contractor personnel at the 45 SW. Unless otherwise noted in this volume, both shall be referred to as Pad Safety for simplicity. Likewise, the term Pad Safety Officer is interchangeable with Operations Safety Manager.

2.1.3.1. General Responsibilities. Pad Safety shall participate in meetings and events as directed by Wing Safety, including the following:

2.1.3.1.1. Observe, evaluate, and ensure Range User compliance of launch and range safety requirements by all personnel within the launch complexes, assembly and checkout areas, propellant and ordnance storage areas, and other areas as described in the tailored AFSPCMAN 91-710 documents for the program. **Note**: Pad Safety personnel shall not be denied access to any area where hazardous operations are conducted, IAW approved procedures.

2.1.3.1.2. Review and provide comments on hazardous procedures to Wing Safety.

2.1.3.1.3. Implement specified safety precautions and impose safety holds, when necessary, during ground operations, as required by procedures or OSP.

2.1.3.1.4. Assist in the resolution of safety problems in areas where Pad Safety has jurisdiction.

2.1.3.1.5. Attend meetings and conferences that involve safety working groups and facility working groups, technical interchange meetings, etc., as necessary.

2.1.3.1.6. Coordinate with the Installation Radiation Safety Officer (IRSO) to ensure enforcement of the Radiation Control Program in all areas where launch vehicles, payloads, and their related hazards are located.

2.1.3.1.7. Coordinate with Bioenvironmental Engineering and Environmental Health (both Health Physics and Industrial Hygiene) on environmental health hazards.

2.1.3.1.8. Immediately notify Environmental Health, Wing Safety, Range Scheduling (30 SW)/Cape Support (45 SW), the installation Fire Department and the Command Post anytime an incident involves an environmental health hazard.

2.1.3.1.9. When present, Pad Safety shall ensure the emergency evacuation of personnel from launch complexes and facilities, and that operations are halted when a lightning hazard is imminent IAW the various safety plans.

2.1.3.1.10. Respond to mishaps and/or incidents IAW the Wing Installation Emergency Management Plan (IEMP).

2.1.3.1.11. Assist Range Users on safety related issues.

2.1.3.2. Hazardous and Safety Critical Pad Support. Pad Safety shall provide oversight of Range User activities when the hazards of the activity are unique and not covered by OSHA, and when hazardous operations have the potential to endanger beyond the boundaries of the launch complex, as follows:

2.1.3.2.1. Ensure compliance with established directives and procedures during hazardous and safety critical operations.

2.1.3.2.2. Assess procedure deviations and resolve with Wing Safety, as necessary.

2.1.3.2.3. Ensure the number of personnel is kept to a minimum in designated safety clearance zones IAW Wing Safety approved procedures. **Note**: Pad Safety shall be included in the maximum allowable manning level, unless Wing Safety determines that adequate support can be provided from a remote location.

2.1.3.2.4. Ensure a comprehensive safety briefing is conducted and understood by participants prior to the start of a hazardous operation.

2.1.3.2.5. In conjunction with the Range User, control personnel access into safety clearance zones during hazardous operations.

2.1.3.2.6. Advise the operation control authority on whether or not to stop operations when a hazardous condition or a safety compromise exists.

2.1.3.2.7. Allow operations to resume only after the imminent danger no longer exists and safety requirements are met.

2.1.3.3. Notifications.

2.1.3.3.1. Immediately notify the appropriate agency (Command Post at the 30 SW and Wing Safety at the 45 SW) of any launch vehicle or payload mishap, hazard, handling malfunction, or other incident creating or contributing to an unsafe condition for personnel or critical hardware.

2.1.3.3.2. Verbally notify Wing Safety of any violation of this document as soon as possible. If requested by Wing Safety, a written report shall be provided to Wing Safety within five calendar days of the violation.

2.1.3.4. Flight Termination System (FTS) Installation, Checkout, and Status. Monitor and verify the installation, checkout, and status of the FTS in accordance with Wing Safety instructions at locations designated by Wing Safety, including submarines.

2.1.3.5. Inspections.

2.1.3.5.1. Inspect all explosive areas and facilities at least annually to determine compliance with the requirements of this document and AFMAN 91-201, *Explosives Safety Standards*. These duties may be performed by Pad Safety or another Wing Safety office, e.g., weapons safety (SEW).

2.1.3.5.2. Inspect critical facilities prior to the start of a hazardous operation or as directed by Wing Safety.

2.1.3.5.3. Inspect new and modified critical facilities prior to the initial startup operation, prepare inspection reports on these facilities, and submit the reports to Wing Safety within 15 calendar days of the inspection.

2.1.3.5.4. Audit the execution of procedures for handling ordnance, propellant material, and high pressure gases performed on CCAFS and VAFB at least quarterly.

2.2. Range User Responsibilities. Range Users are responsible for the following:

2.2.1. Launch Complex Safety Control Authority.

2.2.1.1. Reviewing and approving all procedures relating to the performance of any hazardous operation and safety critical operation that are limited to launch complex safety. This does not include maintenance and testing procedures required by this volume and AFSPCMAN 91-710 Volume 3, specified for review by Wing Safety.

2.2.1.2. Reviewing and approving Emergency Evacuation Plans (EEPs) and FEOPs that are limited to launch complex safety.

2.2.1.3. Where the hazard is limited to launch complex safety, ensuring facilities are inspected IAW paragraph **5.8.3.1**

2.2.1.4. Monitoring hazardous and safety critical operations that are limited to launch complex safety.

2.2.1.5. Defining the threat envelopes of all hazardous operations limited to launch complex safety and establishing safety clearance zones to protect launch complex personnel and resources.

2.2.1.6. Reviewing training plans to ensure that all personnel performing hazardous operations limited to the launch complex are provided adequate training to conduct their jobs and tasks properly.

2.2.1.7. Ensuring that adequate personnel protective equipment (PPE) and training required to comply with approved procedures, OSPs, GOPs, and Facility Safety Data Packages (FSDPs) is available to all personnel entering the launch complex.

2.2.1.8. Coordinating with and supporting Pad Safety in carrying out required inspections.

2.2.2. Conduct of Operations.

2.2.2.1. Planning and conducting hazardous and safety critical operations IAW Wing Safety approved procedures.

2.2.2.2. Planning and conducting operations IAW the current edition of the applicable OSP for the launch complex, facility, or area in use, including ordnance and propellant operations areas.

2.2.2.3. Planning and conducting other operations IAW the current edition of other safety plans, as applicable.

2.2.3. Notification of Hazardous and Safety Critical Operations to Range Agencies.

2.2.3.1. Notifying Cape Support (321-853-5211) for the ER and Range Scheduling (805-606-8825) for the WR at least 24 hours before the start of any hazardous or FTS-related operation. The following information shall be provided: date, time, nature of the operation, location, and procedure or task number.

2.2.3.2. Notifying Wing Safety and Pad Safety of all hazardous and safety critical operations and tests including FTS-related operations.

2.2.3.3. Notifying Wing Safety and Pad Safety at least 30 calendar days before the scheduled erection of a launch vehicle and/or payload.

2.2.4. Document Preparation and Maintenance.

2.2.4.1. Developing and implementing a GOP in accordance with **Attachment 2** to cover operations conducted on the ranges.

2.2.4.2. Developing and implementing procedures and general instructions to cover all operations conducted on the ranges.

2.2.4.3. Developing, obtaining Wing Safety approval, and implementing procedures related to hazardous and safety critical operations. **Note:** The designation of a procedure as "Hazardous" or "Non-Hazardous" is evaluated on a case-by-case basis and does not necessarily result in mandatory Pad Safety coverage of the operation. The requirements for hazardous procedures may be found in **Attachment 3**.

2.2.4.4. Obtaining Wing Safety approval of new procedures or revisions to previously approved procedures when the hazard is not confined to the user's established control area boundary, or when concurrent operations of another range user could be affected.

2.2.4.5. Developing and implementing a program to control hazardous energy sources by locking and tagging IAW lockout/tagout approved procedures.

2.2.4.6. Developing, obtaining Wing Safety approval, and implementing a propellant off-load plan and procedure.

2.2.4.7. Developing, obtaining Wing Safety approval, and implementing an Emergency Response Plan (ERP) for graphite/epoxy composite overwrapped and Kevlar-wrapped pressure vessels.

2.2.4.8. Developing, implementing, and maintaining records for an In-Service Inspection (ISI) Plan IAW the requirements of this volume and AFSPCMAN 91-710 Volume 3.

2.2.4.9. Developing, implementing, and maintaining records for a Nondestructive Examination (NDE) Plan IAW the requirements of this volume and AFSPCMAN 91-710 Volume 3.

2.2.4.10. Developing, implementing, and maintaining records for a recertification program for ground pressure vessels in accordance with Eastern Space and Missile Center (ESMC) Technical Report (TR)-88-01, *A Guide for Recertification of Ground Based Pressure Vessels and Liquid Holding Tanks*, American Society of Mechanical Engineers (ASME) Post Construction Committee (PCC)-3, *Inspection Planning Using Risk-Based Methods*, and/or National Aeronautics and Space Administration (NASA)-Standard (STD) 8719.17, *Requirements for Ground-Based Pressure Vessels and Pressurized Systems*.

2.2.4.11. Developing and maintaining hazardous facility inspection records and submitting reports to Wing Safety, as required.

2.2.4.12. Developing and implementing a Ground System Test Plan for ordnance facilities and areas, as required.

2.2.4.13. Obtaining Base Civil Engineering approval for compliance with AFI 32-2001, *Fire and Emergency Services (F&ES) Program*.

2.2.4.14. Obtaining Base Medical approval for procedures in accordance with AFMAN 40-201, *Radioactive Materials (RAM) Management*, AFMAN 91-110, *Nuclear Safety Review and Launch Approval for Space or Missile Use of Radioactive Material and Nuclear Systems*, and any Wing-specific supplements or instructions.

2.2.4.15. Preparing and maintaining OSPs as needed and directed by Wing Safety, this function is accomplished by Pad Safety at the 45 SW.

2.2.4.16. Developing and implementing a Dual Crane Lift Plan, if required. Dual crane operations are considered hazardous, regardless of load, and require launch complex safety control authority approval. Additionally, Wing Safety approval is required when dual crane operations are used to hoist hazardous loads containing explosive potential.

2.2.4.17. Developing and implementing a training plan for all Range User personnel performing hazardous and safety critical procedures and operations and submitting an outline of this training plan to Wing Safety for approval. **Note:** Wing Safety will only

evaluate the training plan for areas that could lead to a mishap caused by inadequate training and could affect workers of other employers, range assets, and the general public.

2.2.4.18. Developing pathfinder requirements in coordination with the launch complex safety control authority. Additionally, Wing Safety will be coordinated with when pathfinder operations have the potential to affect launch area personnel or the general public.

2.2.5. Operational Duties.

2.2.5.1. Ensuring required support and emergency elements approved by Pad Safety have continuous access to any area where hazardous conditions could occur.

2.2.5.2. Obtaining Pad Safety concurrence to proceed before starting any hazardous and safety critical operations and before resuming any operation that has been interrupted. **Note:** Interruptions include such events as a safety hold, shift change, evacuation, or breaks.

2.2.5.3. Before initiating hazardous or safety critical operations, the following shall be accomplished:

2.2.5.3.1. Pre-operation and shift change briefings.

2.2.5.3.2. Pre-operation and shift change inspections to verify proper system, facility, and area configuration; personnel and equipment support; and use of a Wing Safety approved procedure.

2.2.5.4. Maintaining an accurate written or computerized record of events during launch countdown, to support potential safety mishap investigations.

2.2.5.5. Observing, evaluating, and enforcing compliance with Wing Safety requirements by all personnel within launch complexes, assembly, and checkout areas, propellant and ordnance storage areas, and other areas as deemed appropriate by Wing Safety.

Chapter 3

GROUND OPERATIONS POLICIES

3.1. Personnel Safety. It is the policy of the ranges that all personnel shall be protected during the performance of operations.

3.2. Stopping Unsafe Operations.

3.2.1. Any employee may shut down operations in the event of an imminent danger condition, i.e., any worksite condition, practice, or operation that causes or presents a hazard that can reasonably be expected to result in immediate death, serious physical harm, or severe damage to equipment or the environment.

3.2.2. Personnel observing an unsafe operation or practice shall report their observations to one of the following individuals:

3.2.2.1. A safety representative.

3.2.2.2. Any operational supervisor.

3.2.2.3. Personnel in the chain of command who exercise supervisory authority.

3.2.2.4. A contracting officer or contracting officer's representative.

3.2.3. Notification of Action. Any action taken by any of the individuals as authorized above to stop an unsafe operation where imminent danger is involved shall be followed by direct verbal, telephone, or radio communication and notification to Wing Safety, the Squadron Commander, the Group Commander, or their designated representative.

3.2.4. Notification of Work Stoppage. The Air Force Contracting Officer or Administrator for an Air Force Construction Contract shall be immediately notified of any work stoppage.

Chapter 4

DOCUMENTATION REQUIREMENTS

4.1. Ground Operations Plan (GOP). GOPs shall be developed IAW the requirements in **Attachment 2** and submitted to Wing Safety for review and approval.

4.1.1. The GOP provides a detailed description of hazardous and safety critical operations for processing aerospace systems and their associated ground support equipment (GSE). Along with the related launch vehicle's Missile System Prelaunch Safety Package (MSPSP), the GOP is the medium from which missile system prelaunch safety approval is obtained.

4.1.2. Incremental drafts of the GOP shall be provided to Wing Safety 45 calendar days before the Preliminary Design Review (PDR), and Critical Design Review (CDR), or equivalent program activities, but no later than one year before the projected date the hardware will arrive at the ranges.

4.1.3. The final GOP shall be submitted 45 calendar days prior to the Pre-Ship Review (PSR) or equivalent program activity.

4.1.4. The GOP shall be approved before the start of any hazardous operations.

4.2. Test and Inspection Plans. Test and inspection plans shall be developed to document the initial and recurring validation of component compliance and assessment of hazards. Test and inspection plans shall be developed for the following items that include, but are not limited to, material handling equipment, ground support pressure vessels, and ground support propellant systems. Specific requirements for each of these systems are discussed in this volume.

4.2.1. Equipment and System Logs and Test Records.

4.2.1.1. Unless otherwise specified in a separate part of this volume that addresses a particular class of system or equipment, logs and test records shall be maintained on critical ground support systems and major fixed equipment. Logs and test records shall comply with the following:

4.2.1.1.1. Logs and test records shall contain chronological entries including:

4.2.1.1.1.1. Records of use or running time.

4.2.1.1.1.2. Maintenance.

4.2.1.1.1.3. Modifications.

4.2.1.1.1.4. Tests, inspections, acceptable parameters, and results.

4.2.1.1.2. Discrepancies and out of specification results shall be clearly identified.

4.2.1.1.3. Resolution of discrepancies and out of specification results shall be noted.

4.2.1.2. Logs and test records shall be maintained for the life of the system/equipment.

4.2.1.3. Logs and test records shall be available to Wing Safety upon request.

4.2.2. Hazardous Facility Inspection Records and Reports. Unless otherwise specified in a separate part of this volume that addresses a particular class of facility, inspection records of hazardous facilities shall comply with the following:

4.2.2.1. Hazardous facility inspection records shall be maintained by Facility Operators and/or Range Users in accordance with AFMAN 91-201, AFI 91-202, Defense Explosives Safety Regulation (DESR) 6055.09, and this volume.

4.2.2.2. At a minimum, hazardous facility inspection records shall include discrepancies and discrepancy resolution. These records shall be available to Wing Safety upon request.

4.2.2.3. Written reports describing actions taken to correct discrepancies shall be submitted to Wing Safety within 15 calendar days, or sooner if requested by Wing Safety.

4.2.2.4. Explosives Facility and/or Area Ground System Test Plan. A floor plan layout for all explosives facilities and/or areas showing all grounding system test points shall be developed and maintained by the Facility Operator and/or the Range User.

4.3. Safety and Emergency Plans.

4.3.1. OSPs.

4.3.1.1. OSP Review and Approval.

4.3.1.1.1. At the ER, OSPs shall be developed by ER Pad Safety and submitted to Wing Safety for review and approval 30 calendar days before initial use. Range users shall provide data to Pad Safety for the development of OSPs. Final OSPs shall be coordinated with the Range User.

4.3.1.1.2. At the WR, Range Users shall develop their OSPs in accordance with paragraph **4.3.1.2** Incremental draft versions of the OSP shall be submitted to the Launch Vehicle Safety branch (30 SW/SEAL) for review and comment 45 calendar days prior to the PDR, CDR, and PSR, or equivalent program activities. The final version of the OSP shall be supplied to 30 SW/SEAL no later than 45 calendar days before the start of any hazardous operations at Vandenberg AFB. An approved site-specific OSP is required prior to the start of operations.

4.3.1.2. OSP Data Requirements. OSPs shall meet the following requirements:

4.3.1.2.1. OSPs shall be developed for all hazardous operating areas including launch complexes and associated areas and facilities (e.g., booster processing, satellite processing, reusable launch vehicle (RLV) unique activities).

4.3.1.2.2. OSPs shall be developed for unique, but frequently repeated, operations that require special or detailed safety considerations not addressed in this publication.

4.3.1.2.3. OSPs shall clarify and provide detailed safety requirements that are particular to the operating area or operation in question.

4.3.1.2.4. At a minimum, OSPs shall contain, address, or provide reference to the following:

4.3.1.2.4.1. A scaled map(s) of the operating area identifying hazardous and safety critical systems, locations, or features including, but not limited to, propellant holding areas, explosive storage areas, high pressure vessels, emergency evacuation routes and assembly points, safety control areas, and warning lights.

4.3.1.2.4.2. A complete explanation of all aural/visual warning systems in the operating area including the required personnel response.

4.3.1.2.4.3. The safety badging (permit) system at the operating area with details, such as requirements for obtaining the safety badge, access control, and safety badge types for different personnel categories.

4.3.1.2.4.4. Visitor control information, including restrictions on access during hazardous operations and requirements for safety briefings.

4.3.1.2.4.5. Personnel requirements, including, but not limited to, smoking areas,; eating and drinking areas; handling of work clothes due to exposure to hazardous, toxic, or flammable materials; work hour restrictions; and tool tethering requirements.

4.3.1.2.4.6. Fall protection surveys and plans.

4.3.1.2.4.7. PPE requirements.

4.3.1.2.4.8. Procedures for reaction to lightning watches and warnings.

4.3.1.2.4.9. Procedures for general emergencies such as fire, explosion, and propellant spills.

4.3.1.2.4.10. FEOPs.

4.3.1.2.4.11. EEPs.

4.3.1.2.4.12. Lockout/tagout plans and procedures.

4.3.1.2.4.13. Confined space operations surveys, plans, and procedures.

4.3.1.2.4.14. Hot work plans and procedures.

4.3.1.2.4.15. Self-inspection program and inspection schedules for hazardous operating areas.

4.3.2. Facility Emergency Operating Plans.

4.3.2.1. FEOPs shall be developed by facility operators and submitted to Wing Safety for review and approval at least 45 calendar days before facility use, unless otherwise agreed upon. FEOPs describe necessary measures to assure safety of personnel, government resources, and operations essential to establish safe conditions. Conditions that should be addressed in the FEOPs include, but are not limited to, response to fire and response to spill, leak, or release of hazardous commodities. Topics that should be addressed in FEOPs include notifications and announcements, safing of systems, evacuation routes, and emergency evacuation assembly point (EEAP) locations. FEOPs are typically combined as a subset of another publication such as an Operations Safety Plan, but this format is not a requirement. The Wing Safety offices are available to provide guidance if required by the Range User.

4.3.2.2. FEOPs shall also address emergency and recovery procedures for a seismic event (WR only). These procedures shall detail emergency shutdown procedures and inspections of critical systems to ensure operation of safety controls were not compromised during the seismic event. An assessment of the facility and its components shall be completed before resuming normal operations.

4.3.3. Emergency Evacuation Plans.

4.3.3.1. EEPs detailing safety and emergency actions shall be developed by facility operators and posted in every building, facility, and area.

4.3.3.2. EEPs shall include the following information:

4.3.3.2.1. Identification of exit/egress routes.

4.3.3.2.2. Identification of primary and alternate EEAPs; EEAPs shall be designated by signs.

4.3.3.2.3. Responsibilities of supervisors and personnel for duties assigned in an emergency.

4.3.3.2.4. Actions to be taken to safe an operation.

4.3.3.2.5. Methods of communication including aural warning systems and public address (PA) announcements.

4.3.3.2.6. Location of fire alarm boxes and other emergency activation devices.

4.3.3.2.7. Required emergency equipment and PPE.

4.3.3.2.8. Required personnel training.

4.3.3.2.9. Reporting requirements such as, but not limited to, Squadron Commander or Command Post.

4.4. Procedures.

4.4.1. General Requirements for Procedures.

4.4.1.1. Procedures and general operating instructions for all operations conducted on the ranges shall be developed.

4.4.1.2. All procedures shall be written IAW requirements provided in **Attachment 2**. **Note**: When a procedure references another source (e.g., technical order, another procedure), it should be made available for review upon request.

4.4.1.3. Brief summaries of all procedures shall be submitted as part of the GOP review and approval process. At that time, the operating procedure summaries shall be designated as "Hazardous," "Non-Hazardous," or "Safety Critical." These designations shall be justified in the operating procedure summaries. Wing Safety may designate additional processes and operations as "Hazardous" or "Safety Critical."

4.4.1.4. Revisions to procedures shall be submitted to the launch complex safety control authority for review and approval. If the hazard potential can effect outside the launch complex, Wing Safety must also review and approve the procedures.

4.4.2. Hazardous and Safety Critical Procedures.

4.4.2.1. Procedures for hazardous and safety critical operations shall be developed IAW the requirements in **Attachment 3**. Emergency actions shall be included in the procedures. Approval of hazardous and safety critical procedures shall not be given until the pertinent data sections of the MSPSP and GOP have been reviewed and approved.

4.4.2.2. Disapproval of a formally submitted procedure may result in an additional 30 calendar day (45 calendar days for new programs) review time submittal and possible delay

of operations. Range Users new to the ranges are encouraged to provide a draft of a typical procedure for early review.

4.5. Range User Training Plan. A training plan listing all training courses used for personnel involved with hazardous or safety critical operations and procedures shall be submitted to Wing Safety as part of the GOP.

4.6. Mishap Reporting.

4.6.1. Mishaps Involving Air Force Personnel and Property. Reporting criteria for mishaps involving Air Force personnel and property are established in AFI 91-204, *Safety Investigation and Hazard Reporting*.

4.6.2. Accident Notification Plan. An Accident Notification Plan shall be developed by the Range User and coordinated with Wing Safety to ensure proper and timely notification of mishaps. The plan shall be included in the GOP.

4.6.3. Support to Investigations. The Range User will provide reasonable support for mishap investigations, including providing access to all pertinent documents and personnel who may have relevant information.

4.7. Debris Recovery Plan (DRP).

4.7.1. A Debris Recovery Plan (DRP) is needed to address any inadvertent vehicle impact on land or near shore. This includes all prelaunch, launch, landing activities, and any unmanned aerial system (UAS) operations.

4.7.2. The Range User shall review and comply with existing AF plans and directives regarding debris recovery. **Note**: In the event of an AF-convened mishap investigation, custody of debris evidence may need to transfer to the investigation team and be kept within safety channels until released.

4.7.3. Range Users shall provide the DRP to Wing Safety no later than 60 days prior to a static fire or launch date for approval, prior to initiating operations.

4.7.4. The DRP shall include, at a minimum, the following information:

4.7.4.1. Identification of responsible agencies for DRP procedures (to include environmental clean-up).

4.7.4.2. Identification of key personnel.

4.7.4.3. Initial response actions.

4.7.4.4. Safing, recovery and removal actions.

4.7.4.5. Debris storage (e.g., location, protection requirements).

4.7.4.6. Support requirements (e.g., photographic, aerial, cranes, trailers).

4.7.4.7. Recovery hazards and mitigations (e.g., batteries, ordnance).

4.7.4.8. Debris identification and classification template (e.g., dimensions, weight, potential fragment types, hazardous materials and amounts, Global Positioning System (GPS) location where debris was recovered).

Chapter 5

GROUND OPERATIONS SAFETY REQUIREMENTS

5.1. Ground Operations Personnel Requirements.

5.1.1. Personnel Training, Certification and Experience. A list of personnel training, certification, and experience requirements shall be available as part of the Range User training plan.

5.1.2. Ground Operations Safety Orientation and Training.

5.1.2.1. All Range Users shall ensure that their personnel receive formal safety, fire prevention, and occupational health orientation and training before receiving a controlled area badge. The employer is responsible to ensure the training is adequate and complete.

5.1.2.2. Unique personnel training and certification requirements for hazardous operations such as ordnance, crane operations, forklift operations, and self-contained atmospheric protective ensemble (SCAPE) operations shall be specified in the appropriate procedures.

5.1.3. Work Time Restrictions.

5.1.3.1. Range Users are responsible for the physiological or psychological readiness of their personnel to participate in critical operations.

5.1.3.2. Each duty period for mission ready and mission support personnel, including participation in a launch or launch attempt activity, shall be preceded by an available rest period.

5.1.3.3. Planned duty for personnel in either mission ready or mission support should normally be 8 hours, starting when the individual reports for duty. Those personnel identified to support operational tests shall not be scheduled for duty during the planned rest period.

5.1.3.4. Hazardous Operations and Prelaunch Attempts. The following criteria shall be used for determining hours worked versus rest time for all personnel who work with hazardous systems, materials, or components, or who accomplish prelaunch functions that require a high degree of concentration:

5.1.3.4.1. Maximum 12-hour shift, unless approved by Wing Safety or a USAF Squadron Commander, with at least 8 hours of rest after 12 hours of work.

5.1.3.4.2. A maximum of 60 hours per week.

5.1.3.4.3. A maximum of 14 consecutive calendar days.

5.1.3.5. Consecutive Launch Attempts.

5.1.3.5.1. When 12-hour shifts are required and launches are rescheduled on a 24-hour basis, consideration shall be given for a 48-hour launch delay after 3 consecutive back-to-back launch attempts.

5.1.3.5.2. In the event mission impacts or operational requirements necessitate 12-hour shifts, mission ready personnel shall not be scheduled for more than 5 consecutive

shifts without a 48-hour break and mission support personnel shall not be scheduled for more than 6 consecutive shifts without a 24-hour break.

5.1.3.5.3. Mission Ready Crew Rest Waiver Authority. Crew rest and/or rest period requirements for mission ready personnel can only be waived by the Chief of Safety or the Space Wing Commander.

5.1.3.6. 30 SW Additional Work Restrictions.

5.1.3.6.1. In the event of a missile accident, emergency, or operational necessity, the duty time limits defined in this volume may be exceeded with the expressed knowledge of the 30 SW Commander or Vice Commander, commanders of tenant organizations, or the 30 SW Chief of Safety for personnel under their respective control.

5.1.3.6.2. When mission requirements dictate, the duty period may be extended to 12 hours by the first level supervisor. Rest periods and break periods shall be provided according to appropriate regulations and negotiated agreements.

5.1.3.6.3. If, after a complete evaluation of the potential hazards involved, mission requirements dictate a duty period in excess of 12 hours, the following criteria shall apply:

5.1.3.6.3.1. For mission ready personnel, the duty periods may be increased to 14 hours or rest periods may be waived with the express knowledge of the 30 SW Commander or Vice Commander, WR Commander, Operations Groups Commander, or the Chief of Safety.

5.1.3.6.3.2. For mission support personnel, the duty period may be increased to 14 hours with the expressed knowledge of the applicable division chief or equivalent level supervisor.

5.2. Hazardous Ground Operations General Requirements.

5.2.1. Pathfinder Requirements.

5.2.1.1. In coordination with the Range User, Wing Safety shall determine which procedures require a pathfinder and its necessary fidelity. These pathfinder operations shall be documented in the GOP.

5.2.1.2. Before the first use of applicable hazardous procedures (e.g., operations involving live ordnance, pressure systems, propellants, RLV decontamination), including contingency procedures, pathfinder operations shall be conducted at the ranges using inert or dummy ordnance, non-pressurized systems, or non-fueled systems.

5.2.1.2.1. Handling operations shall be performed with inert or dummy equipment that simulates the flight unit in form, fit, function, weight, and center of gravity.

5.2.1.2.2. Pressure and propellant system operations shall be performed with equipment that simulates flight equipment valve connections and operations.

5.2.1.2.3. Pathfinder operations shall use GSE that will be used for flight operations.

5.2.1.2.4. Wing Safety and the Range User shall jointly develop acceptance criteria for pathfinder operations and evaluate whether the acceptance criteria have been met.

5.2.2. Control of Access to Hazardous Operations. The launch complex authority shall establish personnel limits, entry control, and control areas for all hazardous operations with Wing Safety approval. When hazardous Range User operations have the potential to impact areas outside of their user control area boundary, Wing Safety shall approve these and any deviations.

5.2.2.1. Personnel Limits for Hazardous Ground Operations.

5.2.2.1.1. Personnel limits shall be established for all hazardous operations and tasks and approved by Wing Safety.

5.2.2.1.2. The supervisor in charge of the building or operation is responsible for maintaining personnel load limits for that building or operation.

5.2.2.2. Control of Access to All Hazardous Operations.

5.2.2.2.1. Hazardous areas shall be fenced, barricaded, or cordoned off and personnel access control maintained at a central control point.

5.2.2.2.2. Access roads shall be closed by barricades, guards, or signs during hazardous operations for positive control of personnel and vehicles. Emergency vehicles shall not traverse the controlled area if another route is available.

5.2.2.2.3. A returned space vehicle shall be regarded as a hazardous system, and access shall be subject to entry control procedures and personnel restrictions for hazardous ground operations until all systems are placed into, or confirmed to be in a safe state.

5.2.2.3. Personnel Restrictions for Hazardous Ground Operations.

5.2.2.3.1. Non-essential personnel shall leave hazardous areas (safety clearance zones) before the start of operations.

5.2.2.3.2. Whenever a warning light status is changed or an audible signal is sounded, a PA announcement shall precede it and identify the reason for the change.

5.2.2.3.3. Each facility and/or area shall have instruction signs informing personnel of the area aural and warning light scheme before entry.

5.2.2.3.4. The buddy system shall be used in all hazardous operations.

5.2.2.3.5. Area Warning Lights.

5.2.2.3.5.1. A flashing green light indicates the controlled area is open to normal work. Hazardous commodities may be present in the area but no hazardous operations are in progress. Access shall be positively controlled.

5.2.2.3.5.2. A flashing amber light indicates a hazardous operation is in progress in the controlled area. Non-essential personnel shall be cleared from the controlled area. Personnel shall not enter without permission from the launch complex safety control authority. If the controlled area extends beyond the user controlled area boundary, Pad Safety permission is also required.

5.2.2.3.5.3. A flashing red light indicates an emergency situation in the controlled area. All personnel shall evacuate the controlled area to the EEAP. This signal shall be accompanied by the sounding of an audible alarm and a PA announcement. This

signal is also used to clear all personnel from a launch complex before a launch, or for a hazardous operation that requires clearing the complex, such as wet dress rehearsal or static fire. At the WR, a flashing red light also designates a dangerous operation for ballistic missile operations; for example, Force Development Evaluation (FDE) operational test programs where work is performed under the strict control of technical orders (T.O.s).

5.2.3. Hot Work Operations.

5.2.3.1. Hot Work Operating Standards. Hot work (open flame) operations including welding, soldering, cutting, brazing, grinding, or heating of materials in such a manner as to cause a source of ignition shall be conducted in accordance with AFMAN 91-203 (Chapter 27, *Welding, Cutting, and Brazing*), 29 CFR 1910.252, *Welding, Cutting and Brazing - General Requirements*, or American National Standards Institute (ANSI) Z49.1, *Safety in Welding, Cutting, and Allied Processes*.

5.2.3.2. Hot Work Operations Training and Certification. All welders shall be trained and certified by competent authority to standards no less than those established by the American Welding Society (AWS).

5.2.3.3. Hot Work General Operating Requirements.

5.2.3.3.1. A written permit shall be obtained from the Fire Marshall before performing hot work.

5.2.3.3.2. Locations where hot work will be routinely performed may operate on an indefinite permit if that area is subject to periodic Fire Department inspections.

5.2.3.3.3. A fire watch shall be maintained during and after the hot work until such time the fire watch determines that the combustion hazard no longer exists.

5.2.3.3.4. On a case-by-case basis, the Fire Marshall may establish a requirement for the Fire Department to perform the fire watch. **Note:** Normally, fire watches are conducted by the Range User; however, there may be instances when, after consultation with Wing Safety on any unique hazards or operating environment considerations (such as a nearby fueled spacecraft, ordnance, hypergolics), the Fire Marshall determines a Fire Department engine crew on-site is warranted.

5.2.3.3.5. Proper housekeeping and protective shields and barriers shall be used to prevent inadvertent combustion.

5.2.3.3.6. Combustibles shall be kept at least 35 feet away from the operation.

5.2.3.3.7. A suitable fire extinguisher shall be available.

5.2.3.4. Hot Work Within Ordnance or Propellant Areas. Hot work within ordnance or propellant areas shall be coordinated with Wing Safety or Pad Safety as well as the range Fire Department.

5.2.3.5. Hot Work on Containers and Lines That May Have Contained Explosives or Flammables. Hot work shall not be performed on containers and lines that may have contained explosives or flammables and that have not been properly cleaned and purged.

5.2.4. Control of Hazardous Energy Sources. Hazardous energy sources shall be controlled through a lockout/tagout program that complies with the requirements of 29 CFR 1910.147, *The Control of Hazardous Energy (Lockout/ Tagout)*, AFMAN 91-203 (Chapter 21, *Hazardous Energy Control*), ANSI/American Society of Safety Engineers (ASSE) Z244.1, *The Control of Hazardous Energy Lockout, Tagout, and Alternative Methods*, and/or an equivalent standard.

5.2.5. Confined Space, Tank Entry, and Tank Cleaning.

5.2.5.1. Personnel who enter and work within permit-required confined spaces shall comply with appropriate controls as defined in 29 CFR 1910.146, *Permit-Required Confined Spaces*, ANSI/ASSE Z117.1, *Safety Requirements for Entering Confined Spaces,* AFMAN 91-203 (Chapter 23, *Confined Spaces*), and/or an equivalent standard.

5.2.5.2. All Range Users, contractors, and subcontractors who will be entering confined spaces other than the contractor's equipment and flight hardware shall contact the Wing Safety Occupational Safety Office at the start of the project to obtain information about the confined space.

5.2.6. Tethering of Equipment.

5.2.6.1. Hand-held tools, equipment, and personal belongings shall be tethered in any area where dropped objects could pose a hazard to personnel.

5.2.6.2. Hazards to be considered in determining tethering requirements include direct contact with personnel or the consequences of damaging critical hardware providing the potential of latent or immediate hazards to personnel from damaged hardware.

5.3. Personal Protective Equipment.

5.3.1. The Range User shall comply with all applicable federal, state, and Operations Safety Plan PPE requirements.

5.3.2. All PPE shall be compatible with the hazardous materials involved. PPE for propellant handling and ordnance operations shall be subject to approval by Wing Safety and Bioenvironmental Engineering.

5.3.3. Based on a hazard assessment, appropriate attire that minimizes exposed body areas and potential for mishaps shall be identified in operating procedures for hazardous and safety critical operations in industrial and missile operating areas.

5.4. Fall Protection. The Range User shall comply will all federal, state, and facility-specific fall protection requirements. **Note**: If the Range User is using an AF facility, additional fall protection requirements may apply.

5.5. Smoking Areas.

5.5.1. The Range User shall observe and use applicable industry standards for smoking areas. No smoking signs shall be posted as directed by the range Fire Department. **Note:** Selection of designated smoking areas, their ash receptacles, and ventilation systems is subject to the review and approval of the Fire Department. No smoking and smoking areas in the complex should be clearly designated by lines painted on the concrete or asphalt surfaces and appropriately marked by signs.

5.5.2. Designated Non-Smoking Areas. Smoking is prohibited at all times and flame-producing devices shall be prohibited within the following areas:

5.5.2.1. Within 100 feet of any propellant storage tank.

5.5.2.2. On gantries or service towers.

5.5.2.3. Within 100 feet of the test stand while propellants are being transferred or during the time propellants are aboard the launch vehicle and/or payload.

5.5.2.4. In the vicinity of the launch vehicle and/or payload during and after ordnance installation.

5.5.2.5. In missile impact areas where radioactive contamination, ordnance, or fuels are present.

5.5.2.6. In any area displaying NO SMOKING signs.

5.5.2.7. In all propellant operating and storage areas except in specifically designated smoking areas.

5.6. Operating Restrictions Due to Lightning.

5.6.1. General. Conditions under which launch complexes, launch vehicle and payload assembly areas, and other hazardous areas shall be cleared due to a threat of lightning shall be specified in the OSP (see paragraph **4.3.1.2.4.8**).

5.6.2. Lightning Watches and Warnings.

5.6.2.1. The Range User shall comply with operational restrictions during lightning watches and warnings as established in Wing Safety approved Operations/Facility Safety Plans. See **Table 5.1** for a description of ER and WR lightning watch and warning criteria.

Table 5.1. Eastern and Western Range Lightning Watch and Warning Criteria.

	Lightning Watch	Lightning Warning
Eastern Range	(Phase I) Forecast for lightning within 5 or 6 nautical miles of centroid of a specific lightning alert area, expected within 30 minutes.	(Phase II) Lightning is imminent or occurring within the 5 or 6 nautical mile boundary of a centroid of a specific lightning alert area.
Western Range	When the potential for lightning/thunderstorms is expected to occur within 10 nautical miles of any location on VAFB. The desired lead time for this watch is 2 hours. The watch is forecast for a period of time that lightning/thunderstorms are expected to be within 10 nautical miles.	When lightning is observed within 10 nautical miles of VAFB.

5.6.2.2. The Range User shall provide steps to procedurally safe propellants and ordnance during lightning watches and warnings when required by the Operations/Facility Safety Plans or Wing Safety. Examples of other considerations for inclusion in the Operations/Facility Safety Plans are provided in **Table 5.2**.

Table 5.2. Examples/Lessons Learned for Operating Restrictions Due to Lightning.

Don't initiate SCAPE operations, propellant tanking and detanking, hoisting hazardous materials or 1.1 to 1.4 class ordnance, or other hazardous operations that can't be secured within the lightning watch/warning timeframe. If an operation is in progress, begin safing the system so as to have the area secured and evacuated before the forecasted lightning warning timeframe. Any mitigations, such as certified lightning protection systems, which may permit continued operations. Non-ordnance and non-propellant operations, if approved, may continue during lightning watches and warnings, for example, installation of electrical cables, mechanical components, flight hardware, stud standoff and wing installation.

5.6.2.3. Additional wing-specific information regarding meteorological and weather warning notification procedures may be found in 45 SWI 15-101, *Weather Support*, and 30 SWI 15-101, *Weather Support*.

5.7. Operating Restrictions Due to High Winds.

5.7.1. Personnel shall not work on scaffolds during storms or high winds. Due to the many types of scaffolding, it is impractical to determine specific wind criteria for work stoppage, so Range Users should abide by relevant OSHA or AFI requirements, or the following guidelines.

5.7.2. For winds of 18-29 knots as measured on or closest to specific facilities, no work shall be performed on the exterior surface of umbilical or mobile service towers or other tall structures unless spider staging or similar suspended work devices are safely secured to the structure.

5.7.3. For winds of 30 knots or more as measured on or closest to specific facilities:

5.7.3.1. No work shall be performed on the exterior surfaces of umbilical or mobile service towers or other tall structures except for emergency tasks.

5.7.3.2. Work performed during emergency conditions shall be approved by the launch complex safety control authority, and all suspended work devices shall be secured to the structure.

5.8. Facility Use.

5.8.1. Facility Use General Requirements.

5.8.1.1. Facilities shall be used within the limits of their design. If facilities are leased from the USAF, the Range User shall coordinate with Wing Safety and Civil Engineering for proper use within the limits of their design.

5.8.1.2. Only those operations that are consistent with facility design, materials, equipment, and personnel shall be performed in the facility.

5.8.2. Hazardous Facility Use General Requirements.

5.8.2.1. The use of facilities for hazardous storage or processing operations shall be approved by Wing Safety.

5.8.2.2. Facilities used for hazardous activities shall have an FEOP and an Evacuation Plan developed by facility operators.

5.8.2.3. Simultaneous hazardous operations within the same control area are prohibited.

5.8.2.4. Non-hazardous operations within the same control area as an ongoing hazardous operation are prohibited unless a safe distance approved by the launch complex safety control authority can be maintained, or for operations with potential to hazard beyond the launch complex, Wing Safety approval.

5.8.3. Hazardous Facility Inspection.

5.8.3.1. Range User Facility Inspections.

5.8.3.1.1. Facilities shall be inspected before first use, upon modification, before operations, and at least annually, as determined by the Range User, Fire Department, and Wing Safety.

5.8.3.1.2. For facilities licensed/sited for explosives and propellants, inspection reports shall be maintained in accordance with AFMAN 91-201, AFI 91-202, and DESR 6055.09.

5.8.3.1.3. Actions shall be taken to correct discrepancies identified during inspections. Records of discrepancies and discrepancy corrections shall be maintained for 3 years.

5.8.3.1.4. A verbal report shall be made to Wing Safety within the same day of the inspection if discrepancies are found that may delay a planned operation or endanger personnel or material handling equipment (MHE) used to handle critical hardware, or the critical hardware itself.

5.8.3.1.5. Written reports describing actions taken to correct discrepancies identified during inspections shall be submitted to Wing Safety within 15 calendar days or less if deemed necessary by either group.

5.8.3.2. Operations Safety Facility, Complex, and Area Inspections.

5.8.3.2.1. A systematic visual examination of facilities, related GSE, and any work in progress that could cause accidental damage to property or injury to people or affect the launch schedule shall be performed by the launch complex safety control authority, and by Pad Safety when Range User operations in that facility have the potential to endanger personnel or resources outside the launch complex. This inspection deals primarily with aerospace ground equipment (AGE), launch critical associated equipment, maintenance, associated hardware, fire hazards, fall protection, and equipment on the complex.

5.8.3.2.2. A safety inspection shall be performed on launch complexes, explosives storage and processing facilities and areas, and in hazardous processing and checkout facilities according to the following schedule:

5.8.3.2.2.1. Prior to major operations on a schedule as agreed to by the Range User and Wing Safety.

5.8.3.2.2.2. Immediately before the start of any hazardous or safety critical operation.

5.8.3.2.2.3. After any major or safety-related modification has been made to facilities or equipment.

5.8.3.2.3. Explosives storage and operating areas and facilities shall be inspected by Pad Safety at least annually to ensure compliance with explosives safety criteria. Area monthly records shall be reviewed during the annual inspection.

5.8.3.3. Facility Operator Inspections. The facility operator shall inspect explosive storage and operating areas and facilities at least once a month.

5.8.3.4. Facility Spot-Checks. As deemed appropriate by Wing Safety, spot-checks of range facilities shall be performed to ensure compliance with this publication.

5.9. Static Firings.

5.9.1. The safety requirements for a normal launch shall be met during static firings. The appropriate danger area clearing shall be specified in the OSP.

5.9.2. A flight termination system will not be required if the following capabilities are provided:

5.9.2.1. A hold down capability of four times the maximum net thrust throughout the anticipated burn time.

5.9.2.2. A liquid propellant shutoff system approved by Wing Safety for the static firing.

5.9.2.3. Verification that a solid stage, in proximity to a liquid stage undergoing the static firing, cannot be ignited.

5.9.2.4. An analysis of the hold down system showing at least dual fault tolerance against accidental release.

5.9.2.5. For vertical solid motor test firing without active FTS, a thrust termination device, such as an impaler ring above the motor, shall be provided to terminate the motor thrust in case of a restraining test stand structure failure.

Chapter 6

MATERIAL HANDLING EQUIPMENT, CRANE AND HOIST, PERSONNEL PLATFORM, POWERED INDUSTRIAL TRUCK, AND ELEVATOR OPERATIONS

6.1. Overview.

6.1.1. This chapter is divided into five major sections: material handling equipment (MHE) Operations, crane and hoist operations, personnel platform operations, powered industrial trucks, and elevator usage. Requirements for vehicles used to transport hardware onto and off of the ranges are not governed by this chapter, but rather in **Chapter 15.**

6.1.2. MHE is comprised of below-the-hook lifting devices (BTHLD), handling structures, support structures, slings, load positioning (e.g., Hydra Set ®) and load indicating devices (LID), lifting assemblies, and rigging hardware. Slings, BTHLDs, lifting assemblies, rigging hardware, and LIDs are governed by industry standards, e.g., OSHA, ASME.

6.2. Material Handling Equipment (MHE) Operations. The operations requirements for MHE used for handling (lifting, supporting, or manipulating) critical and non-critical hardware are described below. These requirements are applicable to new or modified MHE. The requirements are also applicable to permanent or short-term use MHE and apply whether the equipment is owned, rented, or leased by the government, contractors, or commercial operators.

6.2.1. MHE General Operating Standards.

6.2.1.1. Equipment shall not be used in operations unless it meets the requirements in AFSPCMAN 91-710 Volume 3, Chapter 6, unless otherwise tailored and/or agreed to by Wing Safety.

6.2.1.2. All MHE shall be operated, tested, and maintained IAW the applicable requirements of this publication, OSHA, AFMAN 91-203, and other military and industry standards including, but not limited to, ANSI, ASME, and the National Fire Protection Association (NFPA).

6.2.1.3. All equipment used by the Naval Ordnance Test Unit (NOTU) and that has been approved by the Chief of Naval Operations, Department of Energy, and the DoD for the specific purpose for which it is used shall be considered in compliance with this publication.

6.2.1.4. All users of MHE used for safety critical operations shall have written and approved procedures that cover selection, operation, maintenance, and testing of the MHE used. **Note:** Operations that include maintenance of the MHE and use of these items with no safety critical loads shall not be considered safety critical operations. Those operations that involve MHE and safety critical loads including direct contact, such as supporting the load, or within the immediate vicinity, such as moving the MHE without a load over a hazardous commodity, shall be considered safety critical operations.

6.2.2. MHE General Operator Qualification and Training Requirements.

6.2.2.1. Operator Qualification Requirements.

6.2.2.1.1. Operators shall be mentally and physically capable of safely operating the MHE.

6.2.2.1.2. Operators shall be physically tested for vision and hearing before being assigned to operator duty and annually thereafter.

6.2.2.2. Operator Training and Certification Requirements.

6.2.2.2.1. Operators shall be trained in the safe operation of the MHE used and the hazards to which they are exposed.

6.2.2.2.2. Operator training shall include, but not be limited to, the following topics:

6.2.2.2.2.1. The requirements of the operator manual.

6.2.2.2.2.2. Applicable parts of AFMAN 91-203 and/or ASME B30 series, *Material Handling Equipment*.

6.2.2.2.2.3. Applicable parts of 29 CFR 1910, Subpart N, *Material Handling and Storage*.

6.2.3. MHE General Operations Requirements.

6.2.3.1. All MHE to be used for hazardous operations and/or safety critical operations shall be identified to Wing Safety.

6.2.3.2. All MHE shall be verified as safe for its intended use by the Range User.

6.2.4. MHE General Periodic Test and Inspection Requirements.

6.2.4.1. Load tests shall be conducted with certified weights and/or certified weight fixtures, IAW the requirements of AFSPCMAN 91-710 Volume 3, paragraph 6.2.1.3.

6.2.4.2. All damaged MHE shall be removed from service until all discrepancies are corrected and verified through test or inspection as suitable for service.

6.2.4.3. All MHE shall be marked with the next inspection due date.

6.2.5. MHE Data Requirements. MHE documentation (inspection, test, maintenance, and modification reports, commercial-off-the-shelf (COTS) operating and maintenance manuals, etc.) shall be provided IAW requirements of AFSPCMAN 91-710 Volume 3 data requirements, and shall be maintained by the Range User for the life of the MHE. This documentation shall be made available to Wing Safety for audit upon request.

6.2.6. Sling Operations.

6.2.6.1. Sling Operating Standards. All slings shall be operated, maintained, and tested in accordance with ASME B30.9, *Slings,* and ASME B30.26, *Rigging Hardware*. **Note**: Synthetic web/rope slings should have an overload indicating device when used for safety critical operations.

6.2.6.2. Sling Periodic Test and Inspection Requirements. Slings used to support critical operations shall be inspected and tested to 100% of the manufacturer’s rated load within one year of intended use, unless the Range User has proposed, with supporting risk analysis, and Wing Safety has approved, an alternate test interval. Following modifications and repairs, critical slings shall be proof loaded to the same level as new slings, in accordance with ASME B30.9 and 29 CFR 1910.184. Slings shall be inspected before every use. Sling inspection shall be IAW frequent and periodic inspection methodologies described in ASME B30.9, and shall follow a Wing Safety approved NDE plan.

6.2.7. Load Positioning and Load Measuring/Indicating Device Operations.

6.2.7.1. Load Positioning Device and LID Operating Standards.

6.2.7.1.1. Load positioning devices and LIDs shall be operated, maintained, and tested IAW the manufacturer instructions and the additional requirements described below.

6.2.7.1.2. Load positioning device and LID operators shall be trained and certified IAW manufacturer recommendations.

6.2.7.2. Load Positioning Device and LID Periodic Test and Inspection Requirements.

6.2.7.2.1. Before every use, load positioning devices and LIDs shall be inspected. Load positioning devices and LIDs showing evidence of damage or rejectable criteria shall not be used in operations.

6.2.7.2.2. LIDs used to support critical operations shall be properly calibrated before use. If a wireless remote readout control is used with the LID, it shall be calibrated and display the same weight as the LID. **Note**: Remote control display devices are often used with LIDs when the LID is too high off the ground to be able to read its weight display.

6.2.7.2.3. Load positioning devices and LIDs used to support critical operations shall be inspected and load tested to 100% of the rated load within one year of intended use, unless the Range User has proposed, with supporting risk analysis, and Wing Safety has approved, an alternate test interval. Following any modifications or repairs, critical load positioning devices and LIDs shall be proof load tested to the same level as new load positioning devices or LIDs, to include calibration in accordance with manufacturer instructions. After the proof load test, NDE shall be performed on critical load positioning devices or LIDs per a Wing Safety approved NDE plan.

6.2.8. Handling Structure Periodic Test and Inspection Requirements.

6.2.8.1. Before every use, handling structures shall be visually inspected in accordance with applicable industry methodology and the Wing Safety approved NDE plan. Structures showing evidence of damage or rejectable criteria shall not be used in operations.

6.2.8.2. Handling structures used to support critical operations shall be inspected and load tested to 100% of the rated load within one year of intended use, unless the Range User has proposed, with supporting risk analysis, and Wing Safety has approved, an alternate test interval. Following any modifications or repairs, critical handling structures shall be proof load tested to the same level as new handling structures. After the proof load test, NDE shall be performed on critical handling structures IAW a Wing Safety approved NDE plan.

6.2.8.3. Handling structures fabricated (including fittings and attachment hardware) of ductile materials and exhibiting ductile failure mode at the operating environmental conditions may be exempted by Wing Safety from periodic load testing on a case-by-case basis. Subject to Wing Safety review and approval, such structures may be verified using an alternate approach, based on fracture mechanics and proof-test logic.

6.2.9. BTHLD Operations.

6.2.9.1. BTHLD Operating Standards. All BTHLDs shall be operated, maintained, and tested in accordance with ASME B30.20.

6.2.9.2. BTHLD Periodic Test and Inspection Requirements.

6.2.9.2.1. BTHLDs shall be visually inspected in accordance with frequent and periodic inspection methodologies described in ASME B30.20, and shall follow the Wing Safety approved NDE plan. BTHLDs showing evidence of damage or rejectable criteria shall not be used in operations.

6.2.9.2.2. BTHLDs used to support critical operations shall be inspected and load tested to 100% of the rated load within one year of intended use, unless the Range User has proposed, with supporting risk analysis, and Wing Safety has approved, an alternate test interval. Following any modifications or repairs, critical BTHLDs shall be proof load tested to the same level as new BTHLDs in accordance with ASME B30.20 methodology. After the proof load test, NDE shall be performed on critical BTHLDs in accordance with a Wing Safety approved NDE plan.

6.2.9.2.3. BTHLDs fabricated (including fittings and attachment hardware) of ductile materials and exhibiting ductile failure mode at the operating environmental conditions may be exempted from periodic load testing by Wing Safety on a case-by-case basis. Subject to Wing Safety review and approval, such structures may be verified using an alternate approach based on fracture mechanics and proof-test logic.

6.2.10. Support Structure Operations.

6.2.10.1. Support Structure Periodic Test and Inspection Requirements.

6.2.10.1.1. Before every use, support structures shall be visually inspected in accordance with applicable industry methodology and the Wing Safety approved NDE plan. Structures showing evidence of damage or rejectable criteria shall not be used operations.

6.2.10.1.2. Support structures used to support critical operations shall be inspected and tested to 100% of the rated load within one year of intended use, unless the Range User has proposed, with supporting risk analysis, and Wing Safety has approved, an alternate test interval. Following any modifications or repairs, critical support structures shall be proof load tested to the same levels as new critical support structures. After the proof load test, NDE shall be performed on critical support structures IAW a Wing Safety approved NDE plan.

6.2.10.1.3. Support structures fabricated (including fittings and attachment hardware) of ductile materials at the operating environmental conditions may be exempted by Wing Safety from periodic load testing on a case-by-case basis.

6.2.11. Rigging Hardware Operations.

6.2.11.1. Rigging Hardware Operating Standards. All rigging hardware shall be operated, maintained, and tested in accordance with ASME B30.26.

6.2.11.2. Rigging Hardware Periodic Test and Inspection Requirements.

6.2.11.2.1. Before every use, rigging hardware shall be visually inspected in accordance with ASME B30.26. Any rigging hardware showing evidence of damage and meeting removal criteria as outlined in ASME B30.26 shall be removed from service.

6.2.11.2.2. Rigging hardware used to support critical operations shall be inspected and load tested to 100% of the rated load within one year of use. Following any modifications or repairs, critical rigging hardware shall be proof load tested to the same level as new critical rigging hardware in accordance with ASME B30.26. After the proof load test, NDE shall be performed on critical rigging hardware IAW a Wing Safety approved NDE plan.

6.3. Crane and Hoist Operations.

6.3.1. Crane and Hoist Operating Standards. In addition to the requirements in 6.1, all cranes and hoists shall be identified, tested, maintained, and operated in accordance with ASME B30 series standards, ASME Hoist (HST) standards, Crane Manufacturers Association of America (CMAA) 70, *Specifications for Electric Overhead Traveling Cranes*, CMAA 74, *Specifications for Top Running and Under Running Single Girder Electric Overhead Traveling Cranes Utilizing Under Running Trolley Hoist*, AFMAN 91-203, and NFPA 70, *National Electric Code*. The requirements are also applicable to permanent or short-term use equipment and apply whether the equipment is owned, rented, or leased by the government, contractors, or commercial operators. **Note**: At VAFB, cranes not on VAFB exclusive federal jurisdiction property also require inspection, testing, and certification in accordance with CAL-OSHA requirements.

6.3.2. Crane Operator Training and Certification.

6.3.2.1. All operators of facility cranes used on the range shall have the applicable training and qualifications listed in AFMAN 91-203 (Chapter 12, *Material Handling Equipment*), ASME B30 series, 29 CFR 1910.179, and 29 CFR 1910.180. **Note**: Operators using fixed facility cranes for safety critical operations must be certified on the specific device to be used for lifts.

6.3.2.2. Annual Crane Operator Certification. Annual crane operator certification is required and shall be conducted in three parts:

6.3.2.2.1. Classroom Training and Testing. Employers shall ensure their personnel receive classroom training as evidenced by testing. Employers shall maintain records for each operator they employ.

6.3.2.2.2. Physical Examination. The employer is responsible for obtaining a physical examination of the operator as required by AFMAN 91-203, 29 CFR 1910, 29 CFR 1926, and/or applicable ASME B30 series safety standards.

6.3.2.2.3. Hands-On Training and Certification. The employer shall provide hands-on training, evaluation, and certification in the form of a card that includes the following:

6.3.2.2.3.1. Name of operator.

6.3.2.2.3.2. Certifying agency and certification expiration date.

6.3.2.2.3.3. Type of equipment the operator is certified to operate.

6.3.2.3. Navy Area Crane Operator Certification.

6.3.2.3.1. Portal and mobile crane operators shall be certified according to Naval Facilities Engineering Command (NAVFAC) P-306, *Testing and Licensing of Weight Handling and Construction Equipment Operators*.

6.3.2.3.2. Crane operators not certified according to NAVFAC P-306 shall be trained and certified according to the requirements detailed above.

6.3.3. Crane and Hoist Periodic Test and Inspection Requirements.

6.3.3.1. Daily Inspections.

6.3.3.1.1. Using a pre-operational checklist, daily, or otherwise before first use, inspections shall be conducted on the equipment to be used at the beginning of each shift.

6.3.3.1.2. Daily inspections shall cover the following items:

6.3.3.1.2.1. The functionality of all controls and brakes.

6.3.3.1.2.2. The condition of all components that can be inspected without disassembly other than that required by 29 CFR 1910.179 and whose failure would cause a safety hazard.

6.3.3.1.3. Cranes and hoists are exempted from daily inspection requirements during periods of non-use.

6.3.3.2. Slack Rope Inspections. If a slack rope condition has occurred, inspectors shall be positioned to observe the rope seating in the drum and sheave grooves as the load is reapplied, and concurrently inspect the rope for damage.

6.3.3.3. Crane and Hoist Periodic Test Requirements.

6.3.3.3.1. Cranes and hoists shall be inspected and tested, at a minimum, IAW the requirements and intervals (frequent and periodic) specified by AFSPCMAN 91-710 Volume 3, as applicable.

6.3.3.3.2. Cranes and hoists not used for critical loads shall be load tested to 100% of rated capacity within four years of their intended use IAW the requirements in AFSPCMAN 91-710 Volume 3.

6.3.3.3.3. Following any modification or repair, cranes and hoists shall be proof loaded in accordance with ASME B30.2 to the same level as new cranes and hoists. NDE shall be performed on critical cranes and hoists after the load test per a Wing Safety approved NDE plan.

6.3.3.3.4. Following periodic crane load tests, hooks shall be inspected in accordance with ASME methodology; surface NDE and hook inspection shall be performed on exposed portions of the hook IAW the NDE plan.

6.3.3.3.4.1. Given permanent reference marks from initial measurement of each side of a hook opening, the distance between the marks shall be measured and recorded during periodic investigations. Acceptance/rejection criteria shall be in accordance with ASME B30.10, *Hooks*.

6.3.3.3.4.2. Hook load-bearing attachment holes shall be inspected and their dimensions recorded during periodic inspections.

6.3.3.3.4.3. For hooks having load-bearing holes, hooks with holes having cracks or wear exceeding the manufacturer criteria shall be repaired or replaced.

6.3.3.3.4.4. Hook throat opening and load-bearing attachment holes shall be inspected, per the NDE plan, and throat and load-bearing hole measurements shall be taken and recorded. Measurements and inspection results shall be compared to the acceptance/rejection criteria in ASME B30.10 and manufacturer specifications. Hooks exceeding the inspection criteria shall be repaired or replaced.

6.3.3.4. Periodic Test and Inspection Requirements for Cranes and Hoists Used to Handle Critical Hardware.

6.3.3.4.1. The Range User shall ensure cranes and hoists used to handle critical hardware and used in hazardous environments shall be maintained, inspected, and tested periodically on an annual basis.

6.3.3.4.2. All inspections, tests, and functional validations shall be performed using written procedures that describe safety control areas, emergency procedures, and supervisor and operator responsibilities.

6.3.3.4.3. The annual test shall consist of the following:

6.3.3.4.3.1. Full functional test of all crane control functions, including special protective systems; for example, overspeed, overload, uncommanded motion, fail-safe operation (loss of power), control station selection lock-out, emergency stop, limit switches, spooling monitor

6.3.3.4.3.2. Inspection and load test at 100% of rated capacity in accordance with ASME methodology, and additional requirements for initial load test.

6.3.3.4.3.3. The hoist emergency load lowering system shall be tested to verify that it is fail-safe and function properly. The load shall be lowered a minimum of 2 feet.

6.3.3.4.3.4. The hoist overload detection devices shall be tested to verify that they activate when the test weight is greater than 110% of the rated load.

6.3.3.4.4. Wire rope shall be inspected at least monthly using a go/no-go gauge at numerous random locations to assess reduction in diameter along the entire length of rope. Any broken wire or other observed defects shall be reported for further evaluation.

6.3.3.4.5. Hooks shall be inspected at least monthly for visible cracks or deformities. The tram points shall be measured for throat spread. A straight edge shall be used to evaluate twisting.

6.3.3.4.6. Brakes shall be inspected at least quarterly for the amount of lining remaining and indications of overheating or glazing. The brake shall be adjusted to specifications.

6.3.3.4.7. Crane and hoists are exempted from monthly inspections during periods of non-use exceeding 1 month.

6.3.4. Crane and Hoist Retest and Re-inspection.

6.3.4.1. Following major maintenance or modification, initial acceptance inspection and testing shall be conducted IAW the requirements of AFSPCMAN 91-710 Volume 3, 6.3.2.1.

6.3.4.2. If an accidental overload condition occurs, cranes and hoists shall be subjected to a complete initial re-inspection and retest.

6.3.4.3. The equipment user shall submit a written report to Wing Safety detailing the nature, cause, and effect of the overload.

6.3.5. Dual Crane Lift Operating Requirements. Dual crane lifts are considered hazardous operations without regard to the load. The following is required:

6.3.5.1. The load shall be restricted to no more than 75% of rated capacity for each crane for non-critical lifts. The load shall be restricted to no more than 50% of rated capacity for each crane for critical lifts.

6.3.5.2. All mobile crane dual lifts shall require load cells and cab-installed load indicators.

6.3.5.3. A dry run with a geometric/mass simulator shall be required for all safety critical operations.

6.3.5.4. A Dual Crane Lift Plan addressing the following information shall be submitted to the launch complex safety control authority for review and approval:

6.3.5.4.1. The exact weight (+/- 1%) of the total load including spreader bar/beam, hoist attachments, fixtures, and slings.

6.3.5.4.2. Any dynamic forces that affect the load.

6.3.5.4.3. All crane movements, including trolley, bridge, boom up, down, extension, and swing, and crane travel.

6.3.5.4.4. Center of gravity throughout the complete lift.

6.3.5.4.5. Certification of cranes and crane operators.

6.3.5.4.6. Operating surface capacity compatibility with mobile cranes (paved areas).

6.3.5.4.7. Soil compaction compatibility with mobile cranes (unpaved areas).

6.3.5.4.8. Provisions for a lift director, two-way communication, and spotter(s).

6.3.6. Field and Mobile Cranes. All field and mobile cranes operated on the range for permanent or short term use shall be properly inspected, functionally validated, maintained and certified according to AFMAN 91-203, 29 CFR 1910, 29 CFR 1926, NASA 1740.9, *Safety Standards for Lifting Devices and Equipment*, (only if used in NASA activities or NASA facilities), applicable ASME B30 series standards, applicable state OSHA regulations, and the requirements identified below. These requirements apply whether the equipment is government, Range User, or contractor owned, rented, or leased.

6.3.6.1. The use of mobile cranes to lift critical hardware shall be justified to and approved by Wing Safety on a case-by-case basis.

6.3.6.2. Prior to conducting a critical lift with a mobile crane, the upper limit switch shall be tested for proper functioning by raising an empty hook to the upper limit, activating the upper limit switch and verifying that the hoist stops. After the load is hoisted a small distance, the load shall be left hanging for approximately three minutes (i.e., a holding brake test) to ensure the winch holding brakes functions properly and that there is no load slippage.

6.3.6.3. Mobile cranes used for critical lifts shall be derated to 50% of their original load capacity. The total weight of the load shall not exceed 50% of the crane rated capacity for the given lift radius and load line reeving configuration of the crane.

6.3.6.4. Load charts shall be used as the primary means for determining safe loads for various boom angles. Crane computers shall not be used as a sole means for this determination.

6.3.6.5. Evolutions that actually involve man-rated lifts shall also comply with operational requirements in this chapter and ASME B30.23, *Personnel Lifting Systems*. For man-rated lifts, the total weight of the loaded personnel platform and related rigging shall not exceed 50% of the rated capacity for the radius and configuration of the crane or derrick.

6.3.6.6. Inspection and Test Requirements. Range users utilizing mobile cranes shall submit a data package to Wing Safety for review and approval that provides evidence that the mobile crane meets the following requirements:

6.3.6.6.1. Current maintenance documentation.

6.3.6.6.2. Operator qualifications and certification documentation.

6.3.6.6.3. Proof that operators have performed similar type lifts within one year of planned lift.

6.3.7. Lifting Operations.

6.3.7.1. Pre-Operational Lifting Requirements. The person responsible for supervising lifting operations shall ensure the following:

6.3.7.1.1. The crane has met all of its maintenance, test, and inspection requirements and is operated within its rated capacity.

6.3.7.1.2. The operator is certified.

6.3.7.1.3. The operator remains at the controls the entire time a load is suspended. **Exception:** Exceptions may be approved by Wing Safety, in the interest of operational efficiency, to allow lifting hardware such as slings, spreader bars, BTHLDs, and load positioning/indicating devices to remain suspended while unattended provided all of the following conditions are met:

6.3.7.1.3.1. A procedure documenting such exceptions has been approved by Wing Safety.

6.3.7.1.3.2. The lifting hardware suspended is connected to but not supporting the weight of the objective load; for example, the launch vehicle stage, motor segment, or payload.

6.3.7.1.3.3. The load is scheduled to be lifted within 24 hours.

6.3.7.1.3.4. The load and immediate vicinity are roped off or otherwise identified to prohibit unauthorized personnel entry.

6.3.7.1.3.5. The crane controls are locked in the off position.

6.3.7.1.3.6. The restrictions against people being under the suspended lifting hardware are enforced.

6.3.7.1.4. The vicinity of the lift is controlled so that:

6.3.7.1.4.1. Unauthorized personnel entry is precluded.

6.3.7.1.4.2. Personnel or any part of their bodies are prevented from being under or in the way of the load.

6.3.7.1.4.3. For cranes equipped with booms, the controlled area is defined by the swing radius of the crane and includes all of the rotating superstructure.

6.3.7.1.4.4. A large enough area is cleared so as to protect against flying debris from a dropped object.

6.3.7.1.5. All personnel within the controlled hoisting area wear suitable head and foot protection.

6.3.7.1.6. Previously announced lightning watches and warnings will not cause the load to be in jeopardy.

6.3.7.1.7. All personnel are knowledgeable of the operation to be performed, tasks to be done, route to be traveled, and safety considerations.

6.3.7.1.8. If using a mobile crane, the following criteria shall be met:

6.3.7.1.8.1. The area shall be set up so that the lift is made within the shortest possible radius.

6.3.7.1.8.2. The lift shall be made over the rear of the crane, if possible.

6.3.7.1.8.3. Outrigger floats shall be made of 4 x 4 inch or cross-hatched 2 x 4 inch lumber, a minimum of 4 x 4 feet square or equivalent support.

6.3.7.1.8.4. When using outriggers, they shall be fully extended and raise the crane so that the wheels are off the ground unless the crane is designed for partial outrigger use and has appropriate load rating charts.

6.3.7.1.8.5. No part of the crane or load shall pass within 10 feet of an electrical power line unless the line is de-energized and visibly grounded on both sides of the area of possible contact.

6.3.7.1.8.6. Outriggers and outrigger floats shall be used on flat surfaces. **Note**: Outrigger floats or cribbing may also be needed in areas without a hard surface, such as concrete.

6.3.7.1.8.7. Operators shall not exceed inclination angles specified by the mobile crane manufacturer when locating, then leveling the mobile crane prior to lifting operations.

6.3.7.1.8.8. Operators shall not operate mobile cranes upon unapproved, temporary foundations at unimproved surfaces or on road bearing surfaces not rated for the lifting load.

6.3.7.1.9. Systems shall have sufficient assistant operators or spotters to make sure that all sides of the system are clear for operation.

6.3.7.1.10. All operators or spotters shall have aural communications for coordination between themselves when power is on the system.

6.3.7.1.11. Tag lines shall be used when there is potential for load sway that could damage the article lifted, high value equipment, or flight hardware.

6.3.7.1.12. Tag line personnel shall not impart undesirable motion to the load.

6.3.7.1.13. If the weight of the load to be lifted is not known, the weight shall be estimated with a reasonable degree of accuracy before attempting to lift the load.

6.3.7.2. Attaching the Load. To attach the load, the crane hook shall be positioned directly over the center of gravity of the load before attachment unless authorized in a written procedure approved by Wing Safety.

6.3.7.3. Lifting the Load.

6.3.7.3.1. On the first lift of the day or shift, or on a critical lift, the load shall be raised a few inches, then held in place momentarily, to verify that the brakes operate normally.

6.3.7.3.2. The load shall be lifted to a height sufficient to clear all obstacles in its intended path.

6.3.7.3.3. For hoist angles, cranes are designed to function with the load raised perpendicular with respect to the ground. Cranes are normally designed for vertical lifts. Offset lifts exceeding design specifications shall not be attempted.

6.3.7.3.3.1. Offset angles shall be kept to a minimum. Wing Safety approval is required for all anticipated offset angles exceeding 5 degrees unless the hoist is specifically designed for greater angles. **Note**: Increasing the offset angle increases the strain on the load line, brakes, bearings, sheaves, and other crane parts Pulling the rope with a load component perpendicular to the drum or sheave grooves, at an offset angle, may cause the rope to jump out of the groove and become entangled on the drum or caught between the sheave and its mounting with possible catastrophic results.

6.3.7.3.3.2. When lifting a load, load lines shall not contact load girts, structural members, or any other obstructions.

6.3.7.3.4. Loads may be lifted with the load line off-perpendicular for the purpose of rotating large pieces of hardware if all of the following conditions are met:

6.3.7.3.4.1. There is no safer way to accomplish the rotation.

6.3.7.3.4.2. On an installed crane, the angle is pulled in line with the rotation of the rope onto the drum (lead angle) unless the crane is equipped with a level wind device.

6.3.7.3.4.3. The crane is inspected to ensure that the load line does not engage the load girts, structural members, or any other obstructions at the angle to be used.

6.3.7.3.4.4. Before the lift, the crane is checked to ensure that all rope parts are properly seated in the grooves of the drums or sheaves.

6.3.7.3.4.5. The load is prevented from swinging or otherwise inducing dynamic loads on the hoisting system.

6.3.7.3.5. Mobile or boom-equipped cranes shall not be used for off-perpendicular lifting due to the severe hazard of tipping the crane over or of collapsing the boom.

6.3.7.3.6. Crane maintenance instructions or checklists shall include directions to look for evidence of apparent offset lift damage during inspections.

6.3.8. Suspended Load Operations.

6.3.8.1. Moving a Suspended Load.

6.3.8.1.1. Crane operations involving lifting of hazardous or explosive materials shall be limited to only those personnel required to perform the task.

6.3.8.1.2. A safety clearance zone shall be established in the vicinity around the load and all non-essential personnel cleared to a safe distance.

6.3.8.1.3. Horizontal and vertical travel speeds shall be kept at a safe level and shall be addressed, as appropriate, in procedures.

6.3.8.1.4. Each lift shall be planned so that the load is suspended for a minimum amount of time.

6.3.8.1.5. The load shall not be lifted until immediately before intended travel.

6.3.8.1.6. The most direct route of travel shall be used.

6.3.8.1.7. Loads shall not be carried over critical hardware except when that load is being mated to the critical hardware.

6.3.8.1.8. The landing area shall be prepared so that the load may be set down immediately at the end of travel.

6.3.8.1.9. If the load remains suspended for any length of time, the safety clearance zone shall remain in force.

6.3.8.1.10. The load shall not be carried over personnel nor shall personnel be allowed to place any part of their bodies under any part of the load.

6.3.8.1.11. The load shall be transported as low as possible but at a height sufficient to clear all obstacles that may be in its path.

6.3.8.1.12. An alarm device or personnel accompanying the load shall be used to clear other persons out of the load path.

6.3.8.1.13. Tag lines shall be used to control movement of the load and not impart undesirable motion to the load.

6.3.8.1.14. Tag lines shall be long enough to protect personnel from being struck by the load.

6.3.8.1.15. Tag lines shall be used when there is potential for load swing that could damage the article lifted, high value equipment, flight hardware, property, or cause injury or death.

6.3.8.1.16. Crane operators shall be instructed to stop motion should anyone be in the path of the load or if anyone signals to stop.

6.3.8.1.17. Two-way communication between the test conductor and crane operator shall be maintained.

6.3.8.2. Crane-Suspended Personnel Platforms. Operations involving lifting suspended personnel platforms are prohibited except as provided by AFMAN 91-203, 29 CFR 1910, or 29 CFR 1926, as applicable, in which case the requirements therein apply.

6.4. Personnel Work Platform Operations.

6.4.1. Removable, Extendible, and/or Hinged Personnel Work Platforms.

6.4.1.1. Removable, Extendible, and/or Hinged Work Platform Operating Standards. Personnel work platforms shall be operated, maintained, and tested IAW the manufacturer instructions and the additional requirements listed below.

6.4.1.2. Removable, Extendible, and/or Hinged Work Platform Periodic Test and Inspection Requirements.

6.4.1.2.1. At a minimum, periodic tests shall be performed on all personnel work platforms annually IAW the requirements of AFSPCMAN 91-710 Volume 3 paragraph 6.4.3.

6.4.1.2.2. Visual inspection shall be performed annually on all hinges, attaching points, and other high stress or abuse prone components on all platforms.

6.4.1.3. Removable, Extendible, and/or Hinged Work Platform Recurring Data Requirements. At a minimum, recurring data is required IAW the requirements of AFSPCMAN 91-710 Volume 3, Chapter 6.

6.4.2. Aerial Work Platforms.

6.4.2.1. General Information. Aerial work platforms are commercial (whether or not modified) vehicle-mounted elevating and rotating aerial devices, manually propelled elevating aerial platforms, boom-supported elevating work platforms, self-propelled elevating work platforms, and airline ground support vehicle-mounted vertical-lift devices. See ANSI/Scaffold and Access Industry Association (SAIA) A92 series standards for additional details.

6.4.2.2. Aerial Work Platform Operating Standards. All aerial work platforms shall be operated in accordance with the safe-use practices described in ANSI/SAIA A92 series standards.

6.4.2.3. Aerial Work Platform Designations. All aerial work platforms operated in a hazardous environment as defined by NFPA 505, *Fire Safety Standard for Powered Industrial Trucks Including Type Designations, Areas of Use, Conversions, Maintenance, and Operation*, shall be approved for fire safety purposes by a nationally recognized testing laboratory (for example, Underwriters Laboratories, Inc. [UL], Factory Mutual Engineering Corp [FM]) using nationally recognized testing standards, bear mark(s) evidencing testing, and bear the appropriate designation (D, DS, DY, E, ES, EE, EX, G, GS, LP, LPS).

6.4.2.4. Aerial Work Platform Operations.

6.4.2.4.1. Only qualified and trained personnel shall operate aerial work platforms.

6.4.2.4.2. Usage in NFPA 505 Hazardous Area Classifications shall be restricted to aerial work platforms with the appropriate designation per UL 558, *Standard for Safety, Industrial Trucks, Internal Combustion Engine Powered*, UL 583, *Standard for Safety, Battery Powered Industrial Trucks*, or comparable nationally recognized testing laboratory.

6.4.2.4.3. A risk assessment shall be performed and any identified mitigations emplaced prior to using aerial work platforms in close proximity of critical hardware where inadvertent operation could result in damage of same. See **Table 6.1** for additional guidance.

Table 6.1. Aerial Work Platform Lessons Learned.

In some cases, aerial work platforms are intentionally used in close proximity to critical hardware; for example, to disconnect the rigging from the top of solid rocket motor upgrade (SRMU) segments when they are placed vertically in the stands. Examples of mitigation include padded platform handrails, elimination of single point failures from the hydraulic control system, and stabilization of the chassis to prevent sudden shifting of the platform in case of tire failure. Lessons learned from the SRMU program are listed below: 1. Do not use worn or dry rotted tires on aerial platform vehicles. Sudden tire failure may cause platform translation and impact against sensitive flight hardware. 2. Keep the hydraulic system clean and ensure adequate hydraulic hose chafing guards are installed in the boom articulated joint areas. At least one hydraulic hose failure occurred on the SRMU program, spraying the entire lift with hydraulic oil. 3. Ensure that the hydraulic system components have no unacceptable failure modes. In case of an SRMU aerial platform, reverse command resulted in the vehicle lurching forward and the platform impacting the doorframe. This malfunction was attributed to contamination in the hydraulic system.

6.5. Powered Industrial Truck Operations.

6.5.1. General Information. Powered industrial trucks are commercial (whether or not modified) fork trucks, platform lift trucks, crane trucks, tow tractors, personnel and burden carriers, and other specialized industrial trucks powered by electric motors or internal combustion engines. See ANSI/Industrial Truck Standards Development Foundation (ITSDF) B56 series standards for additional details.

6.5.2. Powered Industrial Truck Operating Standards. All powered industrial trucks shall be operated in accordance with safe-use practices described in ANSI/ITSDF B56 series safety standards.

6.5.3. Powered Industrial Truck Designations. All powered industrial trucks shall be approved for fire safety purposes by a nationally recognized testing laboratory (for example, UL, FM) using nationally recognized testing standards, bear mark(s) evidencing testing, and bear the appropriate designation (D, DS, DY, E, ES, EE, EX, G, GS, LP, LPS).

6.5.4. Powered Industrial Truck Operations.

6.5.4.1. Only qualified and trained personnel shall operate powered industrial trucks.

6.5.4.2. Use in NFPA 505 Hazardous Area Classifications shall be restricted to powered industrial trucks with the appropriate designation per UL 558, UL 583, or a comparable nationally recognized testing laboratory.

6.5.4.3. A risk assessment shall be performed and any identified mitigations emplaced prior to using powered industrial trucks in close proximity of critical hardware where inadvertent operation could result in damage of the hardware.

6.5.4.4. If external attachments, such as special lifting adaptors, are attached to the forks for lifting, the attachment components shall have the proper load rating and meet the appropriate testing requirements in this publication. Additional requirements for marking and manufacturer's certification for special lifting adaptors are found in 29 CFR 1910.178 and associated letters of interpretation on free rigging.

6.5.4.5. Critical loads shall not exceed 75% of the lift truck rated capacity.

6.6. Elevator Operations. Freight elevators used for the movement of ordnance that has been removed from the original shipping containers, toxic propellants, or other hazardous materials shall be controlled remotely (i.e., personnel shall not ride in elevators during movement of these materials).

Chapter 7

ACOUSTIC HAZARD OPERATIONS

7.1. Acoustic Hazard Operating Standards. Acoustic (noise) protection shall be provided IAW the requirements in 29 CFR 1910.95, *Occupational Noise Exposure*, AFMAN 91-203, and AFI 48-127, *Occupational Noise and Hearing Conservation Program*. AF standards do not apply to contractors or contractor employees except where AF personnel or property are endangered or if specifically required by the contract.

7.2. Acoustic Operations.

7.2.1. All potential hazardous noise sources that could be exposed to personnel in the work environment shall be identified to the launch complex safety control authority.

7.2.2. Identified noise sources of concern shall be surveyed.

7.2.3. A means of warning personnel before entering the noise hazard area shall be provided. A description of the hazard and what measures are necessary to ensure the safety of personnel shall be included.

Chapter 8

NON-IONIZING RADIATION OPERATIONS

8.1. Non-Ionizing Radiation Operating Standards.

8.1.1. Personnel and electro explosive devices (EEDs) shall not be exposed to hazardous levels of non-ionizing radiation.

8.1.2. All non-ionizing radiation operations shall be conducted IAW the requirements of the following standards, as applicable:

8.1.2.1. AFMAN 40-201, AFI 48-109, *Electromagnetic Field Radiation (EMFR) Occupational and Environmental Health Program*, and any Wing-specific supplements and instructions for personnel exposure limits.

8.1.2.2. AFMAN 91-201, DESR 6055.09, and American Institute of Aeronautics and Astronautics (AIAA)-S-113, *Criteria for Explosive Systems and Devices on Space and Launch Vehicles*, for radiation limits for ordnance exposure. **Note**: See AFMAN 91-201, DESR 6055.09 and T.O. 31Z-10-4, *Electromagnetic Radiation Hazards*, for guidance with respect to siting ordnance. While Range Users do not site ordnance, they participate in the process and both design/operations may be influenced by siting considerations.

8.1.3. The use and operating location of non-ionizing radiation producing devices shall be approved by Wing Safety and the Installation Radiation Safety Officer (IRSO).

8.2. Radio Frequency Procedures. Radio frequency (RF) transmitters shall be operated using Wing Safety and IRSO approved procedures with the appropriate controls established. AFMAN 40-201, AFI 48-109, and/or any Wing-specific supplements or instructions specify minimum power levels below which RF transmitters are exempt from controls.

8.3. Radio Frequency Operations.

8.3.1. RF Operations General Requirements.

8.3.1.1. General Information. Non-ionizing radiation operations involve RF transmitters in the range of 3 kHz to 300 GHz and optical devices such as lasers.

8.3.1.2. Before transmitting, areas in which power density levels exceed permissible exposure limits shall be controlled to restrict access. **Note**: Area control may be accomplished using appropriate warning signs, lights, and access barriers.

8.3.1.3. The Range User or site operator shall comply with any relevant hazard analyses and/or IRSO-conducted survey recommendations.

8.3.1.4. Where applicable, all safety controls shall be verified by site personnel before operation to ensure proper function. If transmission is required while performing these verifications, the tests shall be performed at low output power or with a dummy load. Steps for performing these verifications shall be incorporated into procedures.

8.3.1.5. All new, modified, or relocated RF transmitters shall be reported to Wing Safety and the IRSO at least 30 days prior to hardware installation so that potential hazards can be evaluated.

8.3.2. RF Transmission Operations for EEDs and Open Grain Solid Propellant.

8.3.2.1. As determined by analyses and tests, local or range-wide RF silence is required during periods of EED installation, removal, and electrical connection or disconnection. At a minimum, RF silence within the complex or area shall be required.

8.3.2.2. Radio transmitters shall be kept away from systems with installed EEDs in accordance with the guidance found in AFI 91-208, *Hazards of Electromagnetic Radiation to Ordnance (HERO) Certification and Management*.

8.3.2.3. Transmitting devices shall be kept a minimum of 50 feet from a fueling area unless they are intrinsically safe.

8.4. Class 1M, 2M, 3B, and 4 Optical/Laser Operations.

8.4.1. Optical/Laser Operating Standards. Optics and lasers shall be operated in accordance with AFI 48-139, *Laser and Optical Radiation Protection Program*, any Wing-specific supplements or instructions, and ANSI Z136.1, *American National Standard for Safe Use of Lasers*, as applicable.

8.4.2. Optical/Laser Procedures. All optical devices and lasers capable of injuring personnel shall be operated using Wing Safety approved procedures with the appropriate controls established.

8.4.3. Optical/Laser Inspection.

8.4.3.1. Periodic inspections shall be conducted to ensure the laser and controls are in safe working condition. **Note**: Conditions of concern include dangerous light radiation, temperature extremes, shatterable materials, contaminating gases, cryogenics, high voltage, and X-rays.

8.4.3.2. Inspection records shall be maintained for the life of the program.

8.4.3.3. Inspection records shall be available at the request of Wing Safety.

8.4.4. Optical/Laser Operations.

8.4.4.1. Laser beams directed toward flammable or explosive materials, pressurized systems, any other system that may become hazardous due to laser energy or directed toward sensitive components of FTSs shall not exceed allowable limits as determined by Wing Safety.

8.4.4.2. Activated lasers shall not be left unattended.

8.4.4.3. Unattended lasers shall be locked out and otherwise safed.

8.4.4.4. If applicable, electrical and mechanical azimuth and elevation stops, and other safety devices shall be verified before performing each laser operation. Steps for performing these verifications shall be incorporated into procedures.

8.4.4.5. All nominal hazardous procedural items shall be accomplished including, but not limited to, the following:

8.4.4.5.1. 24-hr prior notification to the launch complex safety control authority, and Wing Safety if the laser operation extends to areas affecting launch area personnel or the general public.

8.4.4.5.2. Pre-operational PA announcements.

8.4.4.5.3. Clearance of safety clearance zones.

8.4.4.5.4. Posting of applicable warning signs, operation of area and pad warning lights.

8.4.4.5.5. Launch complex safety control authority permission to initiate the hazardous lasing activity. Additionally, Wing Safety permission to initiate hazardous operations is required when the laser operation extends to areas affecting launch area personnel of the general public.

Chapter 9

RADIOACTIVE (IONIZING) RADIATION SOURCES OPERATIONS

9.1. Handling Procedures. Wing Safety and the IRSO shall approve all procedures for handling radioactive sources.

9.2. Ionizing Operations. All ionizing operations shall be planned and conducted so that personnel exposure is as low as reasonably achievable, but in no case shall the maximum dose and exposure limits in 10 CFR 20, *Standards for Protection Against Radiation*, be exceeded.

9.3. General Requirements. In addition to the requirements in this publication, Range Users shall also comply with AFMAN 40-201, AFI 48-109, and any Wing-specific supplements or instructions.

9.4. Spill Notification. CCAFS Cape Support (ER) or Range Scheduling (WR), Wing Safety, and the IRSO shall be notified of the location of radioactive material if spilled, released, or dispensed either by design or accident.

9.5. Flight Radioactive Source Installation. Flight radioactive sources shall be installed as late in the countdown as practical.

9.6. Mishap Notification. Mishaps involving radioactive materials shall be reported in accordance with AFMAN 91-110 and AFI 91-204.

Chapter 10

HAZARDOUS MATERIALS OPERATIONS

10.1. Hazardous Materials Operating Standards. Hazardous operations shall be conducted in accordance with 29 CFR 1910.1200, *Hazard Communication*, 29 CFR 1910.119, *Process Safety Management of Highly Hazardous Chemicals*, 40 CFR 68, *Chemical Accident Prevention Provisions, subpart G Risk Management Plan*, AFI 90-821, *Hazard Communication (HAZCOM) Program*, AFMAN 91-203, and any Wing-specific supplements or instructions for process safety management (PSM) and risk management plan (RMP) requirements. **Note**: The 45 SW point of contact for process safety management is 45 SW/SEA, and the 30 SW point of contact is 30 SW/SEA.

10.2. Hazardous Materials Procedures. Hazardous materials procedures shall be established and include, but not be limited to, the following topics:

10.2.1. Emergency actions for unplanned events such as spills, fires, and personnel contamination.

10.2.2. Actions for decontamination, neutralization, cleanup, and disposal.

10.3. Hazardous Materials Operations.

10.3.1. The use of any hazardous material is subject to Wing Safety approval.

10.3.2. Appropriate control measures shall be established for the use of hazardous materials based on known properties. If properties are unknown, testing shall be performed subject to approval by Wing Safety.

10.3.3. Control measures for hazardous liquids include, but are not limited to, the following criteria:

10.3.3.1. Approved containers shall be used.

10.3.3.2. Containers shall remain capped (covered) when not in use.

10.3.3.3. Quantities shall be limited as approved by the Authority Having Jurisdiction (AHJ). **Note**: The AHJ is the base fire department unless otherwise agreed to in a host-tenant/lease agreement.

10.3.3.4. Work areas shall contain no more than the quantity required for a single shift.

10.3.3.5. Work areas shall not be used for storage unless approved storage cabinets and lockers are available.

10.3.3.6. Local or general exhaust ventilation shall be used to control solvent vapors from reaching toxic levels.

10.3.3.7. Materials that are themselves not hazardous, but that can be hazardous in conjunction with other materials, shall be controlled.

10.3.3.8. The type and quantity of hazardous material shall be compatible with the location and/or facility.

10.3.3.9. When personnel are in confined spaces, hazardous materials and chemicals shall only be used in accordance with a 29 CFR 1910.146 (Permit-Required Confined Spaces)

compliant program. Proper ventilation shall be used to ensure that buildup and/or pocketing of hazardous materials and chemicals have been vented or offgassing does not occur.

10.3.4. In the event of an unplanned toxic release, the Range User shall comply with the Wing IEMP, AFI 10-2501, *Air Force Emergency Management Program*, and any Wing-specific supplements, instructions or plans.

10.4. Restrictions on the Use of Static-Producing and Flammable Materials.

10.4.1. General. Materials prone to electrostatic charge buildup shall not be used within 10 feet of exposed solid propellant grain and static sensitive ordnance.

10.4.1.1. Compliance with the restriction on static-producing materials is handled on a case-by-case basis; however, the following criteria shall be used as a guideline:

10.4.1.1.1. Materials shall not come into contact with a system having an installed EED or other ordnance.

10.4.1.1.2. Materials shall not come within 10 feet of exposed solid propellant grain; for example, no nozzle plug or cover.

10.4.1.1.3. Materials shall not come within 50 feet of exposed flammable liquids.

10.4.1.2. Compliance for the use of materials that could be flammable is handled on a case-by-case basis; however, all materials that are used in the vicinity of ordnance or flammable liquids, such as hypergolic propellants, shall pass the material tests described below.

10.4.2. Material Tests.

10.4.2.1. Materials such as contamination covers, thermal blankets, splash shields, Velcro, tape and any other material located in the vicinity of liquid propellant areas or ordnance areas shall be evaluated for compatibility with their intended use.

10.4.2.2. Results of material compatibility testing shall be made available to Wing Safety. **Note**: A Kennedy Space Center (KSC)/ranges materials list providing the test results of many types of materials is available from KSC Materials Testing Labs.

10.4.2.3. Testing shall address the following material characteristics:

10.4.2.3.1. Ability to build up a charge (triboelectric test).

10.4.2.3.2. Ability of that charge to decay (triboelectric test). **Note**: A material is considered to have good electrostatic dissipation properties if it can dissipate voltage down to 350 volts in 5 seconds using the triboelectric test.

10.4.2.3.3. Flammability.

10.4.2.3.4. Compatibility with other materials and liquids the material may come into contact with.

10.4.2.4. Material restrictions may also arise from other limitations such as being humidity dependent (for charge dissipation) or degradable in sunlight (ultraviolet).

10.4.2.5. Wing Safety shall approve the use of materials based on the test results.

10.4.2.6. Material deficiencies shall result in operational restrictions.

10.5. Hazardous Commodity Lockers.

10.5.1. Positioning and Use of Hazardous Commodity Lockers. Hazardous commodity lockers or cabinets shall be positioned and used for the purpose of storing flammable and combustible liquids in accordance with 29 CFR 1910.106, NFPA 30, *Flammable and Combustible Liquids Code*, and/or AFMAN 91-203.

10.5.2. Hazardous Commodity Locker Inspection. The Range User shall inspect hazardous commodity lockers at least monthly.

10.6. Disposal of Contaminated Liquid Propellant, Gas, or Other Regulated Wastes.

10.6.1. CCAFS Cape Support (ER) (321-853-5211) or Range Scheduling (WR) (805-606-8825) shall be notified of any hazardous material requiring disposal. **Note**: If required, additional guidance shall be obtained from Civil Engineering (Environmental Coordinator) or their designated representative and Wing Safety.

10.6.2. Disposal of toxic or contaminated liquid propellants, gases, or other wastes shall be performed using methods and techniques approved by Wing Safety and Civil Engineering (Environmental Coordinator) IAW Wing-specific hazardous waste management programs and any applicable federal, state, and local regulations.

10.6.3. Range Users shall notify Civil Engineering to obtain proper clearance and support to dispose of wastes before the generation of such wastes.

10.6.4. As needed, those operations involving toxic propellants shall be conducted under the surveillance of Environmental Health and Pad Safety to ensure the safety of personnel involved in the operation and personnel located in adjacent or downwind areas

10.6.5. Records of management and identification of wastes shall be maintained by the organization generating the waste.

10.6.6. Records of disposal of toxic materials shall be maintained by Environmental Flight or their designated contractor as outlined in the applicable hazardous waste management plan at the ranges.

10.6.7. All spills or releases of hazardous substances, including petroleum products, shall be reported to CCAFS Cape Support (ER) (321-853-5211) or Range Scheduling (WR) (805-606-8825) and Pad Safety immediately.

Chapter 11

GROUND SUPPORT AND FLIGHT HARDWARE PRESSURE SYSTEMS OPERATIONS

11.1. Overview. The minimum operational requirements for both ground support and flight hardware pressure systems operations are described below. Operational requirements unique to either category are identified. **Note**: The degree of hazard in a pressure system is proportional to the amount of energy stored, which is a function of both the pressure and the volume stored. As a result, low-pressure, high-volume systems can be as hazardous to personnel as high-pressure systems.

11.2. Pressure Systems Operating Standards.

11.2.1. Only pressure systems that meet the design requirements of AFSPCMAN 91-710 Volume 3 as tailored for each specific program by Wing Safety shall be operated on the ranges.

11.2.2. The handling and storage of propellants shall be IAW Chemical Propulsion Information Agency (CPIA) 394, *Hazards of Chemical Rockets and Propellants*, and DESR 6055.09 and sub tier documents such as AFMAN 91-201 and NAVSEA OP 5, *Ammunition and Explosives Ashore: Safety Regulations for Handling, Storing, Production, Renovation and Shipping.*

11.2.3. Propellants shall be used and stored only in Wing Safety approved facilities designed and suited for that purpose and only during time periods approved by Wing Safety.

11.2.4. Propellants shall be used and stored only in systems that meet the design requirements of AFSPCMAN 91-710 Volume 3 (Chapter 11 and Chapter 12) and shall be approved by Wing Safety.

11.2.5. Portable or mobile vessels and packaging used for transportation of pressurized or hazardous commodities shall be maintained and recertified IAW applicable Department of Transportation (DOT) CFR 49 regulations.

11.2.6. If a DOT vessel is installed on a permanent basis, it shall fall under the recertification requirements for a fixed system.

11.3. Pressure Systems Personnel Requirements.

11.3.1. Pressure Systems Training and Certification. All personnel who operate, test, and maintain pressure systems shall be trained and certified.

11.3.2. Pressure Systems PPE.

11.3.2.1. Selection of PPE. PPE for propellant handling shall be subject to approval by Wing Safety and Bioenvironmental Engineering.

11.3.2.1.1. PPE shall be identified by type and model number in a Wing Safety approved procedure.

11.3.2.1.2. Approval of PPE for an operation depends on the type and volume of propellants involved, the size of the lines, flow rate, pressure, capability to deal with emergencies, and egress accessibility.

11.3.2.1.3. Approvals are not transferable; approvals for similar operations require a reevaluation of the parameters stated above.

11.3.2.1.4. Protective gear shall be compatible with the propellants involved, fire resistant, and non-static producing.

11.3.2.1.5. If the protective gear has limitations, these limitations and subsequent protective actions shall be identified in the operating procedure. **Note**: For example, splash suits are not to be used when hydrazine concentrations can exceed 100 ppm.

11.3.2.2. SCAPE, Category I or IV.

11.3.2.2.1. SCAPE, Category I or IV shall be used for propellant flow and pressurization during the following operations:

11.3.2.2.1.1. Connection and disconnection of wet lines or contaminated (not purged and flushed) dry lines.

11.3.2.2.1.2. Sampling operations.

11.3.2.2.1.3. During propellant flow.

11.3.2.2.1.4. During initial pressurization with propellants until system integrity has been verified (no leaks).

11.3.2.2.1.5. Connections and disconnections of tanker load/off load lines.

11.3.2.2.1.6. Removal and replacement of components in a liquid line.

11.3.2.2.1.7. Opening any liquid system that has not been drained, purged, and flushed with referee fluid.

11.3.2.2.1.8. When the condition of the system is uncertain or unknown.

11.3.2.2.2. The maximum operating time in a Category I SCAPE suit is 110 minutes; however, Wing Safety or Pad Safety can authorize on-station time not to exceed 120 minutes. In extreme temperatures, Wing Safety or Pad Safety can restrict on-station times in Category I SCAPE suits to less than 110 minutes. (ER Only) Personnel using Category I SCAPE suits shall observe a 60-minute rest period between consecutive SCAPE operations; for example, no double-packing.

11.3.2.2.3. For physiological purposes, the maximum operating time in a Category IV or VI SCAPE suit shall not exceed 4 hours at one time.

11.3.2.3. Splash Suits. Splash suits, with self-contained breathing apparatus, shall only be used with systems that contain residual vapors and only after Wing Safety approval. If any liquid is in the system, splash suits shall not be used.

11.3.2.3.1. Removal of full protective gear after system integrity verification shall require Pad Safety approval.

11.3.2.3.2. Emergency protective gear shall be available throughout operations to the crew and other personnel who might be affected in the event of a spill.

11.3.2.3.3. The following non-liquid operations shall require splash suits:

11.3.2.3.3.1. Removal and replacement of components on purged and isolated

liquid lines.

11.3.2.3.3.2. Removal and replacement of components on vent lines.

11.3.2.3.3.3. Connections and disconnections of drained, purged, and isolated lines.

11.3.2.3.3.4. Pressure leak checks when required by procedure.

11.3.2.3.4. With Pad Safety Officer concurrence, the WR allows the use of splash suits during propellant flow after integrity has been established.

11.3.2.4. PPE for Cryogenic Systems.

11.3.2.4.1. All personnel performing liquid oxygen and liquid hydrogen transfer operations, repairs, or adjustments to the system shall wear flame-resistant treated, non-static producing overalls of liquid resistant material, cryogenic service gloves, hoods or face shields, and non-absorbent shoes approved by Wing Safety.

11.3.2.4.2. Personnel performing operations on other cryogenic systems shall be similarly protected, except that flame-resistant treating of coveralls is not required for non-flammable commodities.

11.3.2.5. PPE for Hydrogen Peroxide Transfers. Hydrogen peroxide transfers shall require the use of boots, gloves, and face shields of material approved by Wing Safety.

11.4. Pressure Systems Procedures.

11.4.1. Procedures shall be prepared governing the safe operation, testing, maintenance, and installation of pressurized systems by the agency performing the specific task.

11.4.2. Procedures shall be developed for all operations involving propellants and the checkout of propulsion systems.

11.4.3. Off-loading procedures for payloads and launch vehicles shall be made available at any time propellant is loaded in flight hardware. Off-loading design as outlined in AFSPCMAN 91-710 Volume 3 (Chapter 11 and Chapter 12) addresses the complete system during the complete processing flow. The off-loading procedures shall include integration of the following:

11.4.3.1. Hardware.

11.4.3.1.1. Launch vehicle.

11.4.3.1.2. Launch vehicle fairing.

11.4.3.1.3. Spacecraft.

11.4.3.1.4. Launch complex.

11.4.3.1.5. Process facility.

11.4.3.1.6. Transport vehicle.

11.4.3.1.7. Fixed GSE.

11.4.3.1.8. Portable GSE.

11.4.3.2. Software Command Capability.

11.4.3.2.1. Flight Hardware.

11.4.3.2.2. GSE.

11.4.3.3. Personnel Capability.

11.4.3.3.1. Remote.

11.4.3.3.2. SCAPE.

11.4.3.3.3. Combination of both.

11.5. Pressure Systems Test, Inspection, Maintenance, and Recertification Requirements.

11.5.1. General Test Requirements.

11.5.1.1. Pressure systems shall be initially tested IAW the applicable requirements of AFSPCMAN 91-710 Volume 3 (Chapter 11 or Chapter 12).

11.5.1.2. Any system that has been opened shall be leak tested at 100% maximum operating pressure (MOP) with an inert medium.

11.5.1.3. Pressure relief valves and flex hoses shall be retested within one year of intended use.

11.5.1.4. Pressure gauges and transducers shall be calibrated annually.

11.5.1.5. After any disconnection, modification, or repair of a system, the affected part of the system shall be leak tested.

11.5.1.6. Any component that has been damaged, potentially damaged, repaired, replaced, or modified shall be proof tested IAW the applicable requirements of AFSPCMAN 91-710 Volume 3.

11.5.1.7. After the component proof test, the system or subsystem shall be proof tested, functionally tested, and leak tested. The determination for system proof testing shall be made on a case-by-case basis.

11.5.1.8. New, modified, or repaired propellant systems shall be tested IAW the applicable requirements of AFSPCMAN 91-710 Volume 3 (Chapter 11 or Chapter 12).

11.5.1.9. A log shall be kept on propellant systems to keep track of use, maintenance, modification, testing, and inspection.

11.5.2. General Inspection Requirements.

11.5.2.1. Before use and each operation, facilities and equipment shall be inspected by Range Users and Pad Safety to ensure a safe configuration for the facilities, equipment, and propellants involved.

11.5.2.2. Propellant transfer and storage areas shall be spot checked by Pad Safety, Wing Safety, the Fire Department, and Environmental Health. The appropriate area supervisor shall be advised of any discrepancies noted.

11.5.2.3. Periodic inspections shall be performed on all ground pressure systems IAW applicable procedures.

11.5.2.4. Hazardous ground pressure systems shall be maintained and periodically inspected IAW the ISI Plan. Unacceptable findings from the performance of periodic inspections shall be resolved with Wing Safety participation. These inspections shall be performed during the following periods:

11.5.2.4.1. From initial operational use of the vessel and/or system until the vessel and/or system requires recertification (called the certification period).

11.5.2.4.2. Period from the first recertification effort until second recertification (called first recertification period).

11.5.2.4.3. All subsequent recertification periods.

11.5.2.4.4. The hazardous pressure system operator shall retain all documentation generated as a result of the recertification effort and place this documentation in the system ISI certification and recertification file.

11.5.3. General Maintenance Requirements.

11.5.3.1. Before replacement, storage, or repair of hypergolic or toxic system components, the system shall be purged and flushed of all residual contaminants. System connections and removed components shall be appropriately capped, bagged, and labeled before moving the component.

11.5.3.2. A record shall be kept on the certification of system and component cleanliness.

11.5.3.3. When it is necessary to remove flight hardware components from the system, all broken connections shall be bagged and tagged to prevent moisture or particle contamination from outside sources.

11.5.3.4. If DOT vessels are used in portable GSE, maintenance and operating procedures for periodic hydrostatic tests shall be in accordance with DOT regulations.

11.5.3.5. All maintenance procedures and training shall ensure that personnel performing visual inspections or other checks shall not walk in front of any National Pipe Thread (NPT)-connected components, but shall inspect/observe the NPT connections from a side position to prevent exposure to possible high pressure projectiles.

11.5.3.6. All rupture discs installed in hazardous fluid systems shall be replaced every two years.

11.5.4. Pressure Systems Tests. Tests performed shall meet the applicable requirements as outlined in AFSPCMAN 91-710 Volume 3 (Chapter 11 and Chapter 12). The following requirements apply unless the Range User has proposed, with supporting risk analysis, and Wing Safety has approved an alternative test interval for components:

11.5.4.1. Periodic Test Requirements for Pressure System Components.

11.5.4.1.1. Uninstalled flexible hoses shall be hydrostatically proof tested to 1.5 times their maximum allowable working pressure (MAWP) within one year before use, or pneumatically tested to 1.1 times MAWP once every two years unless otherwise approved by Wing Safety. Installed flexible hoses in functional use shall be hydrostatically tested to 1.5 times their MAWP once a year. **Exception**: This requirement does not apply to flexible hoses that are permanently installed, located,

and operated in an environment that does not exceed the rated temperature, pressure, and shelf life of the hose.

11.5.4.1.2. All permanently installed flexible hoses shall be visually inspected over their entire length at least annually for damaged fittings, broken braid, kinks, flattened areas, or other evidence of degradation.

11.5.4.1.3. Pressure gauges and transducers shall be calibrated within one year before use. Pressure gauges and transducers in functional use shall be calibrated once a year.

11.5.4.1.4. Pressure relief valves shall be tested for proper setting and operation once a year.

11.5.4.2. Testing Modified and Repaired Pressure Systems. Tests performed shall meet the applicable requirements as outlined in AFSPCMAN 91-710 Volume 3 (Chapter 11 and Chapter 12).

11.5.4.3. Pressure Systems Tagging.

11.5.4.3.1. After test and inspection, pressure system components shall be tagged.

11.5.4.3.2. Tags shall provide the date of the last inspection and proof-load test and the component MAWP.

11.5.5. General Recertification Requirements.

11.5.5.1. Recertification Test and Analysis Requirements.

11.5.5.1.1. An engineering analysis for ground support pressure system recertification shall be performed in accordance with AFSPCMAN 91-710 Volume 3, paragraph 11.3.3.

11.5.5.1.2. Vessels and packaging designed to 49 CFR specifications shall be retested to DOT requirements.

11.5.5.1.3. All systems shall be hydrostatically tested at ambient temperatures to 150% of the system MOP.

11.5.5.1.4. Vessels designed to ASME Boiler and Pressure Vessel Code, Section VIII, Division 2 that are prohibited from hydrostatic testing to 150% of the MOP shall be hydrostatically tested to 125% of system MOP at a minimum.

11.5.5.1.5. Cryogenic systems shall be retested in accordance with the applicable requirements of AFSPCMAN 91-710 Volume 3 (Chapter 11 and Chapter 12).

11.5.5.1.6. 100% visual inspection of all joints and connections shall be performed before and after hydrostatic or pneumatic pressure tests. Parts that indicate a change in volume, permanent deformation, leakages, or cracks shall be rejected.

11.5.5.1.7. Visual inspection of the external surfaces of a vessel and the internal surfaces for vessels shall be performed to the maximum extent possible.

11.5.5.1.7.1. Any sign of corrosion, dents, or other damages shall be identified and annotated on permanently maintained recertification documents.

11.5.5.1.7.2. For corroded areas, the corrosion shall be removed.

11.5.5.1.7.3. Using ultrasonic testing (UT), the entire surface area affected by corrosion shall be measured and the remaining wall thickness determined.

11.5.5.1.7.4. Wall areas that are below the minimum required thickness and other unacceptable findings shall be fixed before placing the system back into service.

11.5.5.1.7.5. The susceptibility effects of corrosion such as cracking, delamination, or intergranular attack should be addressed.

11.5.5.1.8. All weld joints on vessels and systems with pressure greater than 500 psig or containing a hazardous fluid shall be 100% volumetrically and surface inspected.

11.5.5.1.8.1. Radiographic examination shall be used to the maximum extent possible.

11.5.5.1.8.2. UT shall be used if radiographic testing (RT) is determined to be ineffective.

11.5.5.1.8.3. Surface and volumetric testing shall be performed after the hydrostatic/pneumatic pressure test only.

11.5.5.1.9. All components and systems shall be leak checked and functionally tested.

11.5.5.1.10. Leaks shall be repaired and components that do not function properly shall be repaired or replaced before starting the subsequent recertification period.

11.5.5.1.11. Pressure vessels will undergo a minimum design metal temperature (MDMT) analysis per ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, UCS-66 to identify their post-1988 Code MDMT requirements.

11.5.5.2. Recertification test pressures should be no more restrictive than the ASME Boiler and Pressure Vessel Code criteria at which the pressure vessel was originally constructed to meet. **Note**: Additional guidance for performing recertification can be found in ESMC TR-88-01. Guidance on the development of ISI plans, damage mechanisms, and NDE techniques can be found in ASME PCC-3, *Inspection Planning Using Risk Based Methods*, as well as National Board of Boiler and Pressure Vessel Inspectors (NBBI) Inspection Code (NBIC) 23, Part 2, *Inspections*. Guidance for addressing non-code pressure vessels can be found in NASA-STD 8719.17, *Requirements for Ground-Based Pressure Vessels and Pressurized Systems*.

11.5.5.3. The recertification period for vessels and systems shall not exceed the shortest period resulting from or determined by the following criteria:

11.5.5.3.1. The shortest service life shall be determined based on the system and components design performance parameters, operational requirements, and inspection and test results.

11.5.5.3.2. Twenty years for systems and for vessels that can be 100% inspected both internally and externally.

11.5.5.3.3. Ten years for systems and for vessels that cannot be 100% inspected internally but can be 100% inspected externally.

11.5.5.3.4. Five years for systems and for vessels that cannot be 100% inspected either internally or externally.

11.5.5.3.5. Manufacturer recommendations.

11.5.5.3.6. Recertification of cryogenic vessels shall be accomplished at a minimum of every 20 years with an internal inspection every 10 years.

11.5.5.3.7. As an alternative to the above criteria, pressure vessel recertification intervals, not to exceed 20 years, may be established using alternative inspection methods (e.g., risk-based methods), with Wing Safety approval.

11.5.5.3.7.1. The determination of recertification intervals using alternative methods shall identify all credible failure mechanisms and associated risks, and define appropriate inspections, tests, and analyses to address the mitigation of pressure vessel failure.

11.5.5.3.7.2. Implementation of a risk-based method approach shall include justification for any deviations from paragraph **11.5.5.1** (Recertification Test and Analysis Requirements).

11.5.5.4. All fixed hazardous pressure vessels shall also be recertified when one or more of the following changes or conditions occur:

11.5.5.4.1. The vessel is planned for service at higher or lower temperatures than those of the previous certification and/or recertification.

11.5.5.4.2. The vessel was removed from service and deactivated without protection from environmental effects; for example, a vessel is not stored inside an environmentally controlled building and does not have a positive internal pressure.

11.5.5.4.3. The vessel was relocated from another installation, agency, or source.

11.5.5.4.4. There is a change of service or commodity, resulting in a new failure mechanism or a change in failure mechanisms.

11.5.5.4.5. The vessel was repaired or modified.

11.5.5.4.6. The vessel has reached the end of its certification or recertification period.

11.5.5.5. Portable or mobile vessels and packaging used for transportation of pressurized or hazardous commodities shall be designed, maintained, and recertified in accordance with 49 CFR. If a DOT vessel is installed on a permanent basis, it shall fall under the recertification requirement for a fixed system.

11.5.5.6. Data File Requirements.

11.5.5.6.1. Recertification data shall be submitted as part of the MSPSP as required in AFSPCMAN 91-710 Volume 3 (Chapter 11 and Chapter 12).

11.5.5.6.2. Documentation shall be maintained in accordance with ESMC TR-88-01.

11.5.5.6.3. Certification files shall be maintained and updated by the hazardous pressure system operator. These files shall be located at the Range User facility at the ranges. Vessels and systems, including mobile and portable systems, that do not have current certification files may be deactivated and removed from service at the direction of Wing Safety.

11.5.5.6.4. Certification files shall be updated within 90 calendar days of completion of periodic inspections and tests.

11.5.5.6.5. Updated information shall include any changes to the current certification files and the following:

11.5.5.6.5.1. Temperature, pressurization history, and pressurizing fluid for both the tests and operations.

11.5.5.6.5.2. Results of any inspection conducted, including the name of the inspector, inspection dates, inspection techniques used, location and character of defects, defect origin, and defect cause.

11.5.5.6.5.3. Maintenance and corrective actions performed from the time of manufacture throughout operational life, including refurbishment.

11.5.5.6.5.4. Sketches and photographs to show areas of structural damage and extent of repairs.

11.5.5.6.5.5. Certification and recertification tests performed, including test conditions and results.

11.6. Pressure Systems Operating Requirements.

11.6.1. General Operating Requirements. Only pressure systems approved by Wing Safety shall be used.

11.6.1.1. Marking.

11.6.1.1.1. Warning signs shall be posted to keep personnel out of areas where pressurization is taking place.

11.6.1.1.2. High and ultra-high pressure systems (systems equal to or greater than 3,000 psig) shall be marked with danger signs indicating the maximum pressure that could be involved.

11.6.1.1.3. Pressure relief valves that present a noise hazard on activation shall be marked with danger signs.

11.6.1.2. Remote Pressurization.

11.6.1.2.1. Remote pressurization is required for the following conditions:

11.6.1.2.1.1. Initial pressurization of any vessel or system with an inert medium. **Note**: For metallic vessels/tanks or systems, initial pressurization at the ranges does not have to be done remotely and/or use blast protection if initial pressurization was performed at off-range sites, such as factory acceptance testing, and followed-up by acceptable post-test inspection.

11.6.1.2.1.2. Any pressurization that will exceed maximum expected operating pressure (MEOP).

11.6.1.2.1.3. Any system or vessel whose design or condition is considered unknown or questionable by Wing Safety.

11.6.1.2.2. Remote initial pressurization at the range can be waived provided all of the following is provided:

11.6.1.2.2.1. The assembled system has been proof tested at a pressure equal to 1.5 times the system MEOP or to an agreed-upon level for tanks with less than 2:1 safety factor for burst;

11.6.1.2.2.2. System configuration has not been modified or repaired before the above testing. Unwelded relief or sensing devices may be replaced after system proof testing; and

11.6.1.2.2.3. Inspection of the pressure system at the launch site verifying damage has not been sustained during transportation or handling before the above testing.

11.6.1.2.3. Suitable barriers shall be used to protect personnel. The Range User and Wing Safety shall determine the adequacy of the blast shield for the pressure and volume of the system.

11.6.1.3. Pressurization Operations.

11.6.1.3.1. Hazardous pressure operations begin at 250 psig.

11.6.1.3.2. Pressure systems shall be inspected upon arrival on the ranges or before first operation.

11.6.1.3.2.1. Where there is evidence that systems have been damaged or overstressed, replacement or, at a minimum, remote initial pressurization shall be required.

11.6.1.3.2.2. Range Users who do not perform initial pressurization remotely shall certify to Wing Safety that no evidence of damage or overstress exists.

11.6.1.3.3. A system and/or facility check shall be made before the start of the pressurization operation.

11.6.1.3.4. During dynamic pressurization of flight pressure vessels/tanks, personnel shall not be exposed any time vessel/tank pressure exceeds 50% of the vessel/tank's design burst rating. Once the flight vessel/tank is in a static condition and verified to not leak, personnel may return to the area as long as vessel/tank pressure does not exceed MEOP.

11.6.1.3.5. Personnel may be present in the area of ground pressure vessels/tanks at all times when pressurized to no greater than MAWP. **Exception**: During initial pressurization of ASME/DOT compliant vessels, personnel must evacuate when pressure exceeds 50% of MAWP during dynamic pressurization activity. After initial pressurization of a ground pressure vessel/tank, it is acceptable for personnel to be present during subsequent pressurizations (static and dynamic states) provided the vessel is still within its design and cycle life.

11.6.1.3.6. If a leak occurs during pressurization, the system and/or subsystem shall be depressurized before adjusting any fittings.

11.6.1.3.7. Flexible hose shall be secured along its length at 6-foot intervals.

11.6.1.3.8. Bolts and fittings shall not be loosened or torqued while the system is under pressure.

11.6.1.3.9. Any system that requires devices such as pressure regulators, pressure-reducing valves, safety valves, or pressure relief valves shall not be activated unless the devices are in place and in operable condition. Only qualified and authorized personnel shall change the setting of these valves and regulators.

11.6.1.3.10. Flight hardware pressure vessels that exhibit a brittle fracture or hazardous leak-before-burst (LBB) failure mode shall maintain a minimum safety factor of 1.5:1 during transport or ground handling operations unless otherwise specified and approved by Wing Safety.

11.6.1.3.11. Flight hardware pressure vessels that have a non-hazardous LBB failure mode shall maintain a minimum safety factor of 1.5:1 during transport or ground handling operations.

11.6.1.4. Entry, Maintenance, and Repair.

11.6.1.4.1. Pressure Systems Entry and Repair Requirements.

11.6.1.4.1.1. Before entry into or repair of a pressurized system, depressurization of that portion of the system is mandatory.

11.6.1.4.1.2. The steps listed below shall be followed:

11.6.1.4.1.2.1. A minimum of 2 block valves shall be closed between the portion of the system to be opened and the source of pressure.

11.6.1.4.1.2.2. The section of line to be opened and the section between the block valves in series shall be vented (depressurized) to atmospheric pressure before the start of work and remain vented (depressurized) during all phases of work.

11.6.1.4.1.2.3. Whenever operations permit, the entire system shall be depressurized before a portion of the system is isolated, vented, and opened.

11.6.1.4.1.2.4. Venting a pressure system shall be accomplished through vent valves. Regardless of pressure, venting shall never be accomplished by loosening or removing a fitting.

11.6.1.4.1.2.5. Lockout devices and warning tags shall be attached to the valves that are isolating the area where system entry will be made.

11.6.1.4.1.2.6. The isolated area shall be verified as being depressurized before opening.

11.6.1.4.2. Open System Work Precautions.

11.6.1.4.2.1. Whenever a depressurized section of a pressurized facility system is to be entered, it is considered open system work and the following precautions shall be observed:

11.6.1.4.2.1.1. Authorization for entry is required from the responsible complex or area supervisor.

11.6.1.4.2.1.2. Personnel limits shall be established in a Wing Safety approved procedure.

11.6.1.4.2.2. When it is necessary to remove components from the system, due care shall be exercised to prevent moisture or particle contamination from outside sources.

11.6.1.4.2.3. Lockout devices and tagging shall be used to ensure systems or subsystems are not operated while work is being performed on the system.

11.6.1.4.2.4. Work requiring lockout and tagging includes the following:

11.6.1.4.2.4.1. The system is depressurized for maintenance.

11.6.1.4.2.4.2. The work to be performed extends to another shift, either same crew next day or a different crew the same day.

11.6.1.4.2.4.3. The work site is left unattended.

11.6.1.4.2.4.4. The valve is not visible at all times.

11.6.1.4.2.4.5. Valves shall be rendered inoperative with a lockout device compatible with the valve material and the lockout devices shall be approved by Wing Safety. See **Table 11.1** for examples of lockout devices.

Table 11.1. Examples of Wing Safety Approved Lockout Devices.

1. Passing a metal chain through the hand wheel and the valve yoke or around the bottom of the valve body or pipe, and then locking the chain.
2. Making the valve inaccessible by locking the housing that encloses the valve, locking the cover of a valve pit, or removing or locking the hand wheel extension of an underground valve or a valve that cannot be reached from the ground or a valve platform.
3. Locking and tagging electrical controls of valves with electric motor actuators.

11.6.1.4.2.5. The following criteria shall be observed when removing locks and tags and returning the system to service:

11.6.1.4.2.5.1. Lockout devices used to render a valve inoperative shall be removed only by an authorized work crew after all work has been accomplished and, when applicable, approved by the proper authority.

11.6.1.4.2.5.2. Tags shall be removed only by the crew placing the tag.

11.6.1.4.2.5.3. Removed tags shall be returned to the crew office and mated with the tear off portion of the tag.

11.6.1.4.2.5.4. Both tag and tear off portion shall be filed or disposed of IAW current practice.

11.6.2. Pressure Systems Containing Liquid Propellant. In addition to the requirements noted above, the following requirements shall be adhered to when operating, testing, and maintaining pressure systems containing liquid propellants.

11.6.2.1. General Operating Requirements for Pressure Systems Containing Liquid Propellants.

11.6.2.1.1. The Fire Department shall be notified of the presence of propellants in any facility as well as any specific firefighting and spill handling support requirements.

11.6.2.1.2. During Any Mishap or Incident. At the ER, the designated Operations Controller is the on-scene commander until relieved by the 45th Mission Support Group Detachment 1 Commander or Fire Chief. Pad Safety advises, ensures control, and supports, as necessary, in accordance with the Wing IEMP 10-2. At the WR, the Support Group Commander or Fire Chief serves as the on-scene commander and Pad Safety advises, ensures control, and supports, as necessary.

11.6.2.1.3. Simultaneous tanking of fuels and oxidizers aboard a launch vehicle/payload is prohibited. **Exception:** Although the intent of Wing Safety is not to allow simultaneous tanking of fuel and oxidizer aboard a launch vehicle/payload, exceptions will be evaluated by Wing Safety after the Range User provides an adequate risk assessment for the specific operation, identifies control measures, and is able to verify the safe conduct of the operation.

11.6.2.1.4. Flight propulsion systems and/or propellant tanks and their associated propellant loading system (including portable vessels and units) shall be commonly bonded and grounded during propellant transfer operations.

11.6.2.1.5. Vapor monitoring equipment shall be used for leak (sniff) checks and general atmosphere monitoring to determine the necessity for PPE. Vapor monitoring equipment shall be approved by Wing Safety and is subject to approval by Bioenvironmental Engineering.

11.6.2.1.6. A toxic vapor check shall be conducted by the operations control authority when personnel are in a facility that has toxic propellants contained in flight hardware and GSE at the start of each 8-hour shift and before entering a facility in which toxic propellant has been left unattended for 8 hours or more.

11.6.2.1.7. In locations where liquid propellants will be handled, water shall be available in the area in sufficient quantities for fire, spill, and medical use. Skin or eye contact with toxic propellants shall be flushed with copious amounts of water. For specified flush periods, consult the Safety Data Sheet (SDS) for the product being used. Appropriate medical attention shall be sought after flushing.

11.6.2.1.8. The supervisor shall notify Wing Safety and Bioenvironmental Engineering of any injury involving toxic or non-toxic propellants.

11.6.2.1.9. Transport of more than 5 gallons of hazardous commodities (to include hypergolic propellants) in non-DOT approved containers shall require a Pad Safety, Security or Hazardous Operations Support (HOS) escort as described in **Chapter 16**. Transport of any quantity of hazardous commodities in DOT approved containers does not require escort.

11.6.2.2. Pre-Operational Requirements for Pressure Systems Containing Liquid Propellants.

11.6.2.2.1. Wing Safety approved procedures shall be used for all propellant operations and the checkout of propulsion systems.

11.6.2.2.2. Before starting operations, the Range User and Pad Safety shall verify that the facility, equipment and personnel are ready by performing the following minimum checks, incorporated into the approved operational procedures:

11.6.2.2.2.1. As required by procedure, Pad Safety and other required support shall be on hand before the conduct of operations.

11.6.2.2.2.2. Pad Safety concurrence to proceed shall be obtained before the conduct of operations.

11.6.2.2.2.3. Personnel qualification and training shall be verified by the respective supervisors.

11.6.2.2.2.4. Wet check of safety showers and water lines before propellant transfer.

11.6.2.2.2.5. Accessibility and operability of emergency exit doors.

11.6.2.2.2.6. Operability of drain and sump systems and their capability for handling a worst case spill and wash down.

11.6.2.2.2.7. Operability of vent systems.

11.6.2.2.2.8. Availability of fire protection.

11.6.2.2.2.9. Proper configuration and grounding of propellant systems.

11.6.2.2.2.10. Weather conditions.

11.6.2.2.2.11. PA announcements, warning lights, and barriers.

11.6.2.2.2.12. Implementation of access control.

11.6.2.2.2.13. All required support on hand.

11.6.2.2.2.14. Availability of approved operating procedures and emergency procedures.

11.6.2.2.2.15. Removal of ignition sources from the area.

11.6.2.2.3. Pad Safety shall inform the Test/Launch Conductor that the appropriate road-blocks have been established, the hazard area cleared, and propellant tanking can begin.

11.6.2.2.4. At the ER, propellant transfer shall not start when the passage of an electrical storm is imminent (within 5 nautical miles). A propellant transfer operation already in progress shall be interrupted or expeditiously concluded at the discretion of Pad Safety or the supervisor in charge of the operation. The OSP for each launch vehicle or facility shall detail the procedure for this situation. At the WR, propellant operations shall not start when lightning is within 10 nautical miles. At the WR, the guidance provided in **Table 5.1** shall be followed.

11.6.2.2.5. Emergency protective equipment shall be provided, as required by Wing Safety.

11.6.2.2.6. The Range User shall provide the maximum source strength based on quantity (gallon or pound) and surface area. The worst case credible spill (quantity)

shall be based on a failure analysis provided to Wing Safety and 45 Weather Squadron Range Weather Operations (ER) or 30 Weather Squadron (WR) before the operation. This information shall be used to determine the downwind sector that shall be evacuated if a large spill occurs.

11.6.2.2.7. Where feasible, the Range User shall develop a means to minimize the surface area of spills by providing a dike or other means of containment.

11.6.2.3. Clearance Zone Controls.

11.6.2.3.1. General Information. Leaks, spills, and venting of toxic propellants may create a toxic cloud. This toxic cloud will diffuse through the atmosphere at a rate that varies with meteorological conditions and spill size. The establishment of clearance zone controls helps mitigate exposure to this hazard.

11.6.2.3.2. A localized safety clearance zone that limits personnel access to those individuals directly involved with the operation and who have the proper protective equipment shall be established.

11.6.2.3.3. A larger safety clearance zone that limits personnel access to those individuals directly or indirectly involved in the operation or mission shall be established. The determination of the larger safety clearance zone shall include consideration of the availability of fencing and Security or HOS check points and the trinitrotoluene (TNT) equivalency of the propellants involved.

11.6.2.3.4. The minimum downwind sector that must be immediately evacuated in the event of a major spill shall be provided to all personnel involved in the operation, and controls shall be in place to implement the control of this sector. The downwind sector shall be defined in the OSP.

11.6.2.4. Operating Requirements for Pressure Systems Containing Liquid Propellants.

11.6.2.4.1. Portable vessels and systems containing incompatible fuels and oxidizers shall not be brought into closer proximity than allowed for permanent systems unless otherwise agreed to in advance by Wing Safety.

11.6.2.4.2. Fire Protection and Environmental Health shall be available as required by procedure.

11.6.2.4.3. All persons and vehicles not absolutely essential to the operation shall be evacuated.

11.6.2.4.4. Before opening a contaminated or toxic propellant system, the system shall be flushed or purged.

11.6.2.4.5. The handling and transfer of toxic materials and propellants shall be monitored by Pad Safety to ensure the safety of personnel involved in the operation and personnel downwind of the operation.

11.6.2.4.6. Vapor monitoring shall be continuous whenever personnel are in enclosed areas having toxic propellants present.

11.6.2.4.7. At the ER, in the case of a lightning warning (lightning within 5 or 6 nautical miles), the system shall be secured; the complex, storage, or operating area

shall be cleared; and the required actions called for in procedures and OSPs shall be taken. At the WR, work stoppage and facility evacuation is carried out IAW **Table 5.1**.

11.6.2.4.8. Reentry into the area of a launch vehicle and/or payload with fuel and oxidizer aboard shall be held to a minimum and shall be subject to approval by Pad Safety.

11.6.2.4.9. Reentry into the area of a launch vehicle and/or payload with only fuel aboard shall also be held to a minimum and shall be subject to the approval of the task or area supervisor.

11.6.2.4.10. Tanking of toxic or cryogenic liquids aboard a launch vehicle or payload during launch countdown shall be performed as late as possible. If tanking is required during launch processing before the countdown, tanking shall be performed as late in the processing as is practical.

11.6.2.4.11. The appropriate actions and evacuations shall take place in the event of an emergency such as a propellant spill.

11.6.2.4.12. Cape Support (ER) and Wing Safety (ER) or Range Scheduling (WR) and Pad Safety (WR) shall be notified of any propellant mishap and incidents, including near misses.

11.6.3. Releases of Toxic Vapors.

11.6.3.1. All releases of toxic vapors shall comply with the Wing IEMP, AFI 10-2501, and any Wing-specific supplements, instructions or plans.

11.6.3.2. At the ER, any plans to vent toxic vapors shall require coordination with the Civil Engineer – Environmental Flight, Bioenvironmental Engineering, and Environmental Health and Wing Safety approval. At the WR, venting operations shall be conducted in accordance with 30 SWI 91-106 and the applicable facility or operations plan.

11.6.3.3. The actual venting operation shall not start without Pad Safety approval.

11.6.3.4. Venting restrictions and controls shall be identified in the appropriate OSP or operating procedure.

11.6.3.5. Venting operations require that the appropriate downwind sector be evacuated.

11.6.3.6. The operations control authority shall verify that Environmental Health is present to verify concentration levels at the control area boundary.

11.6.3.7. The operations control authority shall verify that Security Forces or HOS maintain the appropriate roadblocks.

11.6.3.8. Planned releases shall be IAW permits maintained by Civil Engineering.

11.6.4. Emergency Decontamination of Facilities and Personnel. Emergency decontamination of facilities and personnel shall be accomplished under Pad Safety direction with Environmental Health and the Fire Department performing the decontamination, if required.

11.6.5. Handling Leaks and Spills of Liquid Propellant.

11.6.5.1. PPE for Treating Spills. Personnel treating or flushing major spills of toxic and corrosive propellants shall wear the proper protective clothing and equipment.

11.6.5.2. Leak and Spill Procedures.

11.6.5.2.1. Range Users and supporting agencies shall develop procedures for handling major and minor leaks and spills. CCAFS Cape Support (ER) or Wing Command Post (WR) shall be notified of any spill or release of hazardous material.

11.6.5.2.2. Each area that contains liquid propellants shall have a Wing Safety approved plan for evacuation based on spill size (quantity and surface area) and weather factors.

11.6.5.2.2.1. The approved evacuation plan shall describe the localized safety clearance zone, the general support (larger) safety clearance zone, and the minimum downwind sector to be evacuated in the case of a large spill.

11.6.5.2.2.2. The downwind sector shall be based on the following factors:

11.6.5.2.2.2.1. Maximum source strength based on quantity (gallon or pound) and surface area. The Range User shall determine a worst case spill (quantity) based on a failure analysis.

11.6.5.2.2.2.2. Maximum vapor concentration acceptable for personnel exposure.

11.6.5.2.2.2.3. Average weather criteria, such as wind direction, wind speed, temperature, temperature lapse rate. **Note**: Weather variables can be obtained from the Range Weather Officer.

11.6.5.2.3. These procedures shall be IAW the applicable OSP and shall be submitted to Wing Safety for review and approval.

11.6.5.2.4. Procedures shall address the topics covered in paragraph **10.6**.

11.6.5.3. Handling Minor Leaks or Spills.

11.6.5.3.1. Minor leaks or spills shall be cleaned up with absorbent material where possible. **Note**: For safety and hardware protection reasons, certain spills may require the spill to be washed or flushed with water into collecting tanks or holding basins and disposed of properly to prevent ecological or health hazards. See CPIA 394 for information on treating spills.

11.6.5.3.2. Pad Safety shall be notified of minor leaks and spills and subsequent actions. **Note**: See CPIA 394 and Wing Safety for guidance on disposal of toxic or corrosive propellants.

11.6.5.4. Handling Major Leaks or Spills.

11.6.5.4.1. Major leaks or spills shall be handled according to the situation with the objective of minimizing injury to personnel and damage to facilities and equipment in accordance with the Wing IEMP, AFI 10-2501, and any Wing-specific supplements, instructions or plans. If the requirements described below are in conflict with local guidance, local guidance shall take precedence.

11.6.5.4.2. The following actions shall be taken:

11.6.5.4.2.1. Time and the situation permitting, the source of the propellant flow

and pressure source shall be shut down.

11.6.5.4.2.2. All personnel shall be evacuated out of the area including the minimum downwind sector. Travel shall be upwind or crosswind to the minimum evacuation radius as defined in the Facility Operating Plan, Operations Safety and Area Safety Plan, or the Range User emergency procedure, and away from the downwind sector.

11.6.5.4.2.3. Injured or trapped personnel shall be rescued. Appropriate PPE shall be used.

11.6.5.4.2.4. Adjacent areas shall be alerted.

11.6.5.4.2.5. Personnel shall be available to direct emergency crews and to provide information to assist them.

11.6.5.4.2.6. All personnel shall report to the supervisor at the designated assembly point for head count.

11.6.5.5. Handling Cryogenic or Toxic Liquid Spills.

11.6.5.5.1. Spills of cryogenic liquids shall be flushed with large amounts of water into the surrounding ground surface or a holding basin.

11.6.5.5.2. Spills of toxic or corrosive propellant, or those that could affect the public health or ecology, shall be flushed with water or another neutralizing agent into a collecting tank to be disposed of IAW approved procedures. **Note**: Refer to CPIA 394 Volume III, *Liquid Propellants,* and the Medical Department for guidance. Additional reference sources include the Florida Department of Environmental Protection (ER) or the California Environmental Protection Agency (WR).

11.6.6. Flight Graphite Epoxy Composite Overwrapped Pressure Vessel (COPV) Operations. Only COPVs that meet the applicable design, test, and inspection requirements described in AFSPCMAN 91-710 Volume 3 shall be operated on USSF ranges.

11.6.6.1. If COPVs that contain inert pressurants are in close proximity to propellant tanks, the Range User shall provide test data proving that the composite overwrap is compatible with the propellant in terms of strength degradation, flammability, and ignition/combustion requirements, when personnel are at risk. If this data is not available, the following actions shall be accomplished:

11.6.6.1.1. Verification that the COPV is not in a credible "drip zone" for liquid propellants during ground processing operations.

11.6.6.1.2. If the COPV is in a credible "drip zone", the COPV shall be protected with a coating and/or covers and/or splash shields to guard against contact with potentially incompatible liquids.

11.6.6.1.3. Hazardous vapor detectors shall be used to monitor the propellant tanks.

11.6.6.2. If COPVs will be pressurized to pressures greater than 1/3 of the COPV design burst pressure on USSF ranges, the pressurization shall be performed remotely or a blast shield shall be used to protect personnel. If the vessel is to remain pressurized, personnel

access shall not be permitted for a minimum of 10 minutes after the pressurization is completed.

11.6.6.3. Personnel limits for each operation on or near a pressurized COPV/spacecraft shall be established to minimize personnel exposure to pressurized COPVs.

11.6.6.4. The transport of pressurized COPVs shall only occur on Wing Safety approved routes that minimize personnel and facility exposure. In addition, pressurized COPV transport shall utilize escorts and shall only occur during Wing Safety approved and designated time periods.

11.6.6.5. COPVS shall be protected from damage due to impacts during manufacturing, handling, transportation, assembly, and integration of COPVs into the Range User's system(s).

11.6.6.6. Except for the pressure test requirements of AFSPCMAN 91-710 Volume 3, pressure testing of systems with COPVs shall not exceed the manufacturer MEOP pressure limit without the manufacturer's approval and Wing Safety's agreement.

11.6.6.7. Range Users shall develop and provide to Wing Safety Emergency Response Plans (ERPs). These ERPs shall include contingency safing and backout plans for COPVs (taking into consideration leaks, impacts, and exposure to incompatible chemical agents). If implemented, a real time assessment shall be accomplished and contingency operations taken, as required. The ERP shall be approved by the respective Wing Chief of Safety.

11.6.6.7.1. The Range User shall provide the ERP to Wing Safety at least 45 calendar days prior to the start of hazardous operations involving COPVs.

11.6.6.7.2. The Range User shall obtain approval by the respective Wing Chief of Safety prior to the start of hazardous operations.

11.6.7. Flight Hardware Pressure System Components Service Life and Safe-Life. All pressure vessels and pressurized structures that require periodic refurbishment to meet safe-life requirements shall be recertified after each refurbishment by the same techniques and procedures used in the initial certification, unless an alternative recertification plan has been approved by the procuring agency and Wing Safety.

11.6.8. Flight Hardware Pressure Vessel and Pressurized Structure Quality Assurance Program Requirements. Inspection data shall be periodically reviewed and assessed to evaluate trends and anomalies associated with the inspection procedures, equipment and personnel, material characteristics, fabrication processes, design concept, and structural configuration.

11.6.9. Flight Hardware Pressure System and Pressurized Structure Repair and Refurbishment. All repaired or refurbished hardware shall be recertified after each repair and refurbishment by the applicable acceptance test procedure for new hardware to verify their structural integrity and to establish their suitability for continued service.

11.6.10. Flight Hardware Pressure System and Pressurized Structure Documentation Requirements.

11.6.10.1. Inspection, maintenance, and operation records shall be kept and maintained throughout the life of each pressure vessel and each pressurized structure.

11.6.10.2. At a minimum, the records shall contain the following information:

11.6.10.2.1. Temperature, pressurization history, and pressurizing fluid for both tests and operations.

11.6.10.2.2. Number of pressurizations experienced as well as number allowed in safe-life analysis.

11.6.10.2.3. Results of any inspection conducted, including the inspector, inspection dates, inspection techniques employed, location and character of defects, defect origin, and cause.

11.6.10.2.4. Storage condition.

11.6.10.2.5. Maintenance and corrective actions performed from manufacturing to operational use, including refurbishment.

11.6.10.2.6. Sketches and photographs to show areas of structural damage and extent of repairs.

11.6.10.2.7. Acceptance and recertification tests performed, including test conditions and results.

11.6.10.2.8. Analyses supporting the repair or modification that may influence future use capability.

11.6.11. Flight Hardware Metallic Pressure Vessels with Brittle Fracture or Hazardous LBB Failure Mode Safe-Life Demonstration Requirements. The initial report that documented the fracture mechanics safe-life analysis or safe-life testing shall be periodically revised and updated during the life of the program.

11.6.12. COPV Prelaunch Inspection and Pressure Test.

11.6.12.1. Before the first pressurization of a COPV at the range, an inspection of the vessel shall be conducted to determine if there is evidence of damage to the composite shell. The inspection shall be performed by a certified inspector (according to American Society for Nondestructive Testing (ASNT) standards or a Wing Safety approved equivalent). If this inspection is not possible at the launch base because the vessel is no longer accessible, then it shall be conducted the last time the vessel is accessible for inspection.

11.6.12.2. After arrival at the prelaunch processing facility and completion of the inspection with no evidence of damage to the COPV, but prior to propellant loading or pressurization, COPVs shall be pressure tested to 100% of the maximum ground operating pressure. The minimum hold time for this pressure test shall be 5 minutes. This pressurization shall be conducted remotely or a blast shield shall be used to protect personnel.

11.6.13. COPV Test Data Requirements.

11.6.13.1. Prelaunch inspection and pressure test reports.

11.6.13.2. In-service inspection and recertification test reports for reusable flight COPVS.

11.6.14. Testing Flight Hardware Pneumatic and Hydraulic Components. Pressure gauges and transducers shall be periodically calibrated.

11.6.15. COPVs with Brittle Fracture or Hazardous LBB Failure Mode Safe-Life Demonstration Requirements. The initial report that documented the fracture mechanics safe-life analysis (for metal liners only) or safe-life testing shall be periodically revised and updated during the life of the program.

11.6.16. Flight Hardware Cryostats or Dewars with Brittle Fracture Failure Mode Safe-Life Demonstration Requirements. The initial report that documented the fracture mechanics safe-life analysis or safe-life testing shall be periodically revised and updated during the life of the program.

Chapter 12

RESERVED

12.1. Reserved.

Chapter 13

ORDNANCE OPERATIONS

13.1. Ordnance Operations Procedure Requirements. All ordnance operations shall be covered by a Wing Safety approved operating procedure. This includes transportation of hazardous ordnance across the Range, or any ordnance transported across the Range not in accordance with DOT requirements.

13.2. Ordnance Transportation, Receipt, and Storage.

13.2.1. Ordnance Transportation, Receipt, and Storage Standards.

13.2.1.1. All ordnance transportation, receipt, and storage shall be performed in accordance with DESR 6055.09, AFMAN 24-204, *Preparing Hazardous Materials for Military Air Shipments*, CFR 49, *Transportation*, AFMAN 91-201, and any Wing-specific supplements or instructions, as applicable.

13.2.1.2. Over-the-road and rail shipments to and from the ranges shall comply with DOT requirements.

13.2.1.3. To be acceptable for transportation by any mode, explosives shall have the following items provided to Wing Safety and verified by the Range User before shipment:

13.2.1.3.1. Proper DOT classification for transport.

13.2.1.3.2. An assigned hazard classification hazard class and/or division; storage compatibility group; DOT class, markings, shipping name and label; and the United Nations (UN) serial number.

13.2.1.3.3. Availability confirmation of adequate and suitable storage space on the ranges. **Note**: Availability of adequate and suitable storage space depends on factors such as the hazard classification, the size of the storage containers, and temperature and humidity requirements.

13.2.1.3.4. Availability confirmation of proper connectors and cabling for ordnance checkout if range facilities and equipment are to be used.

13.2.2. Ordnance Transportation General Requirements.

13.2.2.1. Transportation Restrictions. Launch vehicles, payloads, spacecraft, and vehicle stages shall not be shipped to the ranges with ordnance such as EEDs installed unless prior written approval has been obtained from Wing Safety.

13.2.2.2. Ordnance Services Coordination. Shipments by commercial carrier to CCAFS shall be coordinated with CCAFS Ordnance Services. Shipments by commercial carrier to VAFB shall be coordinated with 30th Logistics Readiness Squadron, Distribution Flight - Cargo (30 LRS/LGRDDC).

13.2.2.3. Ordnance Transportation Address. All ordnance shipments including EEDs shall be addressed as shown in **Table 13.1** or **Table 13.2**:

Table 13.1. Ordnance Shipments Address 1

To: Transportation Officer Patrick Air Force Base, FL 32925 Marked for: Manager, Ordnance Services Bldg. 72910 (Munitions Storage Area #2), Cape Canaveral Air Force Station, FL Special Markings: Name of Program Name of Project Monitor or Office Complete Address From: Sender's Name and Address

Table 13.2. Ordnance Shipments Address 2

To: Transportation Officer Vandenberg Air Force Base, CA 93437 Marked for: 30 LRS/LGRDDC 2010 New Mexico Street Vandenberg Air Force Base, CA 93437 Name of Project Monitor and Office Complete Address From: Sender's Name and Address

13.2.3. ER Ordnance Delivery and Receipt.

13.2.3.1. The Range User must schedule ordnance deliveries by calling CCAFS Cape Support (321-853-5211). Once CCAFS Ordnance Services has received an ordnance delivery, they are the only authorized transport service on the base. Ordnance Services will only deliver to locations that have been licensed or sited for ordnance.

13.2.3.2. The Range User shall notify Pad Safety of ordnance deliveries on CCAFS.

13.2.3.3. After receipt at Munitions Storage Area #2 at CCAFS, all ordnance transportation shall be performed by CCAFS Ordnance Services unless specifically approved by Wing Safety.

13.2.4. Ordnance Shipment Inspection.

13.2.4.1. As soon as possible after receipt, a receiving inspection shall be conducted by Ordnance Services (ER) or 30 LRS (WR) and the Range User to ensure that no damage has occurred during shipment.

13.2.4.2. Any shipment discrepancy or DOT violation shall be reported to Ordnance Services (ER) or 30 LRS (WR) and Wing Safety.

13.2.5. Ordnance Storage.

13.2.5.1. Ordnance and propellants shall be stored in facilities specifically designed for that purpose and approved by Wing Safety and/or the Department of Defense Explosive Safety Board (DDESB). Processing facilities shall not be used for the storage of ordnance.

13.2.5.2. Range Users shall make arrangements to remove ordnance from the ranges when it is no longer needed.

13.2.5.3. Range Users shall furnish instructions for the disposition of stored ordnance items to the storage provider upon project termination or when ordnance items are no longer required.

13.3. Ordnance Systems Grounding.

13.3.1. Ordnance Systems Grounding PPE.

13.3.1.1. Personnel handling, installing, or electrically connecting ordnance or working within 10 feet of exposed, solid propellant grain shall wear Wing Safety approved, flame-retardant, non-static producing, long-sleeve, cuffless, full-body garments (coveralls, not smocks) with leg stats, or conductive shoes, and/or wrist stats. If required, Range Users shall submit a sample of the garment for testing.

13.3.1.2. Other persons who may come in contact with ordnance, test equipment when ordnance is connected, or flight hardware when ordnance connections are not complete shall wear the same coveralls and equipment as described above or as required in procedures specific to the subject equipment and operations.

13.3.1.3. Sweaters and jackets shall not be worn as outer garments over protective coveralls.

13.3.1.4. More stringent controls shall be used when necessary to enforce Wing Safety policy. **Note**: For example, all personnel entering a particular control area may be required to wear the proper coveralls.

13.3.1.5. Additional guidance, criteria and lessons learned regarding ordnance system grounding PPE is provided in **Table 13.3**.

Table 13.3. Additional Ordnance System Grounding PPE Guidance and Lessons Learned.

1. The two primary concerns in selecting garments to be worn by personnel handling, installing, or electrically connecting ordnance or working within 10 feet of exposed, solid propellant grain are static and fire. The static concern is self-explanatory. Anti-static smocks may be approved by Wing Safety if there is no significant fire hazard. Fire is a primary concern because of the potential for solid/liquid propellant fires. This concern dates back to the X-248 solid motor mishap in the spin test facility at the ER in 1964. Although the most probable cause for this mishap was static electricity, it was observed the survivors of the mishap would have fared much better had they been wearing full-body protection; in other words, coveralls, rather than smocks. Another key piece of information is the fact that the inadvertent motor initiation occurred during a non-hazardous operation. 2. With the transition of the Air Force and NASA expendable launch programs to the Space Shuttle program in the early 1980s, many activities involved both agencies from a launch vehicle, facility, or personnel point of view. It became increasingly more difficult for safety personnel to ascertain the acceptability of the coveralls being used, particularly with respect to Air Force operations in the Payload Changeout (clean) Room on NASA/KSC's shuttle launch pad. For that reason, the ER Safety Office joined forces with the KSC Safety Office to develop common standards and specifications for coveralls for both non-cleanroom and cleanroom environments. The standardized requirements were documented in the KSC Ground Operations Safety Plan GP 1098, a publication that has since been superseded by other

documents. The following guidance on the selection of coveralls is provided for Range Users.

3. General Criteria for Coveralls:

a. Flame Retardant. Cotton garments meeting the Wing Safety flame retardant requirements should meet the requirements of MIL-C-43122G, *Cloth, Sateen, Cotton, Flame Retardant Treated:* "finished cloth shall have an average time of after-flame of not more than 2.0 seconds, and not more than 40% consumed both initially and following 15 launderings." Per NHB 8060.1B, *Flammability, Odor, and Offgassing Requirements and Test Procedures for Materials in Environments that Support Combustion*, Test 1: "less than 6 inches sample consumed and no sparking, sputtering, or dripping of flaming particles." **Note:** NOMEX garments are not covered by MIL-C-43122F.

b. Thermal Protection. Garments used in solid rocket motor open grain and hazardous ordnance operations should provide a measure of radiant heat and flame contact protection where practical. See Aerospace Medicine, Volume 40, Number 11, *Method and Rating System for Evaluation of Thermal Protection*, November 1969. NASA/KSC blue-collar garments have been tested for thermal protection (*Naval Air Development Center technical memorandum*, 6 March 1979) and provide greater than 14 seconds radiation protection before skin blister at a brightness temperature of 1900°C and greater than 3 seconds flame contact protection before skin blister at a flame temperature of 1220°C.

c. Static Dissipation. Garments meet the Wing Safety static dissipation requirement when voltage drops below 350 volts in 5 seconds at 45 plus 5% relative humidity (maximum) and 75°F temperature (maximum). See NFPA 77, *Recommended Practices on Static Electricity* or NASA KSC Materials Testing Branch Report MMA-1985-79, *Standard Test Method for Evaluating Triboelectric Charge Generation and Decay*.

d. Rescue. Consideration should be given to rescue of personnel during hazardous operations. Rescue aids can usually be applied external to the garments in general use applications. However, because of frequent confining work, rescue straps are mandatory for cleanroom garments used for hazardous operations.

e. Sleeves/Legs. Coveralls should contain full-length sleeves and legs; frocks should contain full-length sleeves.

f. Pockets. Pockets, if any, should be lattice type, arranged not to trap hazardous fluids.

g. Cuffs. Garments should not have cuffs (hazardous fluids must not be trapped).

h. Fasteners. Fasteners should be protected from contact (burning) with the skin.

i. Color. Garments should be white or natural in color to take advantage of flame/heat reflectivity.

4. Detailed Criteria for Non-Cleanroom Coveralls. In addition to meeting general criteria, non-

cleanroom coveralls used in ordnance facilities/operations should meet the following:

a. Garments should be readily identifiable as meeting Wing Safety requirements:

(1) Approved general-use, NASA/KSC hazardous operation coveralls are identified by blue collars.

(2) Aramid (NOMEX) garments containing 1% (minimum) filament wire "Brunsmet" or "Bekinox" or carbon thread in one-quarter inch raised grid pattern (carbon grid suits) are approved. (Carbon thread garments are identified by green rescue straps per Paragraph. 2.16.1.3.d in MIL-C-43122F.)

(3) Aramid (NOMEX) garments (non-carbon grid suits) dipped with a Wing Safety-approved anti-static solution, such as Ethoquad, subject to periodic checks to ensure the anti-static solution remains active, can be used and should be stenciled "KSC Safety Approved." **Note**: Wing Safety prefers that Range Users acquire white blue-collar coveralls per the KSC specification because the coveralls are known to meet requirements and are readily recognizable. Often the available data on other coveralls is insufficient to determine static resistant and/or fire retardant acceptability. In these cases, a sample set of coveralls needs to be provided to Wing Safety for testing by the KSC Materials Laboratory.

b. Coveralls should be properly cleaned to comply with the manufacturer instructions.

5. Detailed Criteria for Cleanroom Coveralls. In addition to meeting the general criteria, cleanroom coveralls used in ordnance facilities/operations should meet the following:

a. The maximum permissible concentration of particles and fibers should not exceed 2,000 particles per square foot of 5 microns and larger, with a maximum of 25 fibers. See ASTM F51-68, *Standard Method for Sizing and Counting Particulate Contaminant In and On Cleanroom Garments,* (1984), U.S. Air Force Technical Order T.O.-00-25-203, *Contamination Control of Aerospace Facilities,* and Johnson Space Center JSCM 5322, *Contamination Control Requirements Manual.* **Note***:* Blue-collar garments should not be used for cleanroom use.

b. Garments should be readily identifiable as meeting Wing Safety requirements.

(1) Approved cleanroom coveralls used in hazardous operations are identifiable in that they are 99% continuous filament NOMEX with approximately 1% conductive nylon filament yarn (carbon impregnated) arranged in a one-quarter inch raised grid pattern (carbon grid suits).

(2) Continuous filament Aramid (NOMEX) garments dipped with a Wing Safety-approved anti-static solution such as Ethoquad, subject to periodic checks to ensure the anti-static solution remains active, are approved and should be stenciled "KSC Safety Approved" or "Wing Safety Approved" (non-carbon grid suits).

c. Non-metallic (e.g., Delrin®) zippers should be used on garments in lieu of buttons/snaps in

the vicinity of flight hardware where the loss of a button/snap is a concern.

d. When rescue provisions are applicable, green NOMEX parachute grab straps suitable for rescue purposes should be provided on the legs, shoulders, torso, and back of the garment. Straps should withstand a pull of 200 pounds. Grab straps should be tacked down by breakaway stitching at the center of the strap length to prevent the strap catching on objects while the garment is being worn.

Note*:* In Air Force contractor-operated cleanroom facilities, facility users are expected to use cleanroom coveralls provided by the Air Force facility operator. Besides the fact that (1) it took a long time to develop the currently approved (carbon-grid) cleanroom coveralls and (2) gaining approval for a new type of coverall could be difficult, logistical considerations are involved. For example, a facility evacuation typically requires the facility user to exit the facility to the outside thereby invalidating the cleanroom garments that are worn. Additionally, it is easier for a facility operator to maintain the necessary inventory for replacement garments rather than a facility user. It is strongly recommended that non-Air Force contractor-managed cleanroom facilities use cleanroom garments that meet the NASA/KSC specifications.

13.3.2. Ordnance Processing Restrictions on the Use of Static-Producing Materials.

13.3.2.1. Materials prone to electrostatic charge buildup shall not be used in the vicinity of ordnance and propellants.

13.3.2.2. Compliance with the restriction on static-producing materials is handled on a case-by-case basis; however, the following criteria shall serve as a guideline:

13.3.2.2.1. Static-producing materials shall not come into contact with a system having an installed EED or other ordnance.

13.3.2.2.2. Static-producing materials shall not come within 10 feet of exposed solid propellant grain; for example, no nozzle plug or cover.

13.3.2.3. Further restrictions and testing requirements are provided in paragraph **10.4**.

13.3.3. Ordnance System Static Ground Point Test. Static ground points in all ordnance and propellant operating and storage facilities shall be tested according to paragraph **14.2.1**.

13.3.4. Ordnance Systems Grounding Operations.

13.3.4.1. Ordnance Systems Grounding Operations General Requirements.

13.3.4.1.1. Ordnance associated equipment such as handling fixtures and missile structures shall be connected to a common ground to ensure that an electrostatic charge cannot build up to levels that can cause ignition of the ordnance.

13.3.4.1.2. Platforms and ladders shall be grounded when used in conjunction with vehicles and/or payloads containing ordnance.

13.3.4.1.3. Launch complex service tower platforms are not necessarily good electrical conductors due to corrosion, paint, and questionable bonding of work platforms to ground. Conductive mats that are grounded to the service tower ground shall be used if proper grounds cannot be achieved by other means. Wrists stats shall be required if proper grounding cannot be attained.

13.3.4.1.4. Grounding system, megger high-voltage checks shall not be performed after initiators are installed or electrically connected unless proper fault protection is provided, as approved by Wing Safety. **Note**: Proper fault protection for grounding system megger high voltage checks can include fuses placed in the leads or other measures, as approved by Wing Safety.

13.3.4.2. Ordnance Systems Grounding Pre-Operational Checks.

13.3.4.2.1. When leg stats or conductive shoes are required, grounding of personnel shall be verified using a conductive shoe tester before the start of an ordnance operation. Leg stat or conductive shoe resistance shall not exceed 1 megohm.

13.3.4.2.2. When wrist stats are required, grounding of personnel shall be checked with an ohmmeter. Wrist stats are required to have a resistance between 0.8 and 1.2 megaohms, in accordance with ANSI/Electrostatic Discharge (ESD) S1.1, *The Protection of Electrostatic Discharge Susceptible Items Wrist Straps*.

13.3.4.2.3. To ensure grounding of personnel, conductive floors shall be verified in all ordnance and propellant operating facilities before operations.

13.3.4.2.4. Conductive floors and terminals shall be verified to be electrically bonded to a grounding system common to the ordnance device before operations.

13.3.4.2.5. Static ground points shall be tested in accordance with AFI 32-1065, *Grounding Systems*.

13.3.4.3. Ordnance Systems Grounding Operating Requirements.

13.3.4.3.1. Touching a grounded surface is required before handling an EED or other static-sensitive ordnance device.

13.3.4.3.2. When hoisting ordnance systems with a crane, a trailing ground connection to the facility ground shall be maintained during the hoist.

13.3.4.3.3. Metal shipping containers shall be grounded before opening the containers.

13.3.4.3.4. Before removing an ordnance item from a shipping container, the specific ordnance item shall be grounded.

13.3.4.3.5. When hoisting ordnance with a crane, the ordnance and/or container and the hook shall be commonly grounded before connecting the hook to the ordnance and/or container.

13.4. Ordnance Operations.

13.4.1. Ordnance Operating Standards.

13.4.1.1. Ordnance operations shall be conducted in accordance with AFMAN 91-201 and DESR 6055.09.

13.4.1.2. All initiators are considered hazardous unless Wing Safety concurs with a downgraded designation.

13.4.2. Ordnance Facility Inspection.

13.4.2.1. All new or modified explosives and propellant facilities shall be inspected and approved by Wing Safety before first use.

13.4.2.2. Range users shall support an annual explosive safety inspection by Wing Safety to determine compliance with explosives safety criteria as defined in this publication, other DoD and USAF standards (for example, AFMAN 91-201 and DESR 6055.09), and the provisions of the Explosives Safety Plan.

13.4.2.3. The annual inspection shall include, but not be limited to, the following explosives storage and operating areas:

13.4.2.3.1. Launch complexes.

13.4.2.3.2. Assembly area processing facilities.

13.4.2.3.3. Support facilities.

13.4.2.3.4. Solid and liquid propellant storage areas.

13.4.2.4. The results of the annual explosives safety inspection shall be reported under the provisions of ESP 1.

13.4.2.5. Ordnance facilities shall be inspected monthly by the facility manager.

13.4.3. Ordnance Operations General Requirements.

13.4.3.1. All hazardous ordnance operations on the ranges shall be monitored and approved by Pad Safety. Hazard division 1.4S ordnance and ordnance systems are not required to meet the design requirements of AFSPCMAN 91-710 Volume 3, Chapter 13; however all ordnance and ordnance systems shall comply with the operations requirements of this volume. Examples of Pad Safety coverage during ordnance operations are provided in **Table 13.4**.

Table 13.4. Examples of Pad Safety Coverage During Ordnance Operations.

1. The receipt of ordnance at the assembly and/or processing area.
2. Resistance and continuity checks.
3. "No voltage" (stray voltage) checks.
4. Hazardous ordnance installation and electrical connection.
5. Solid propellant work involving open grain.
6. Handling of liquid and solid propellant motors, segments, stages, or payloads.
7. Cycling and checkout of safe and arm (S&A) or other safety devices.
8. Destruct system checks.
9. Any render-safe operations.
10. Ordnance removal.
11. Launch operations.

13.4.3.2. Testing of any ordnance circuit or device that could result in personnel injury or death (if the ordnance should fire) shall be conducted with no personnel exposed (remotely, in a test cell, or behind a barricade or shield).

13.4.3.3. Ordnance electrical continuity and resistance checkout shall not be conducted at a launch complex or vehicle or payload assembly area without the written approval of Wing Safety.

13.4.3.4. All test equipment used on the ranges to check out ordnance shall be approved by Wing Safety before use. A list of currently approved instruments shall be maintained by Wing Safety. Applied current shall not exceed 10% of the no-fire current of any EED in the circuit, or 50 mA, whichever is less.

13.4.3.5. No current, voltage, power, energy, or other type of energy source shall be applied to any ordnance device outside of an approved test facility or with personnel in the immediate vicinity of the ordnance device except under the following conditions:

13.4.3.5.1. The operation is covered by an approved procedure.

13.4.3.5.2. Approved equipment is used.

13.4.3.5.3. The system or subsystem is approved.

13.4.3.6. RF silence is required during periods of ordnance installation, removal, and electrical connection and disconnection aboard a vehicle and/or payload. Where practical, the RF control area shall include the entire facility and/or complex. Radiating payloads are handled on an individual basis.

13.4.3.7. Wing Safety, with the assistance of the appropriate Range User, shall provide the Explosive Ordnance Disposal (EOD) team with familiarization training on the launch vehicle and/ or payload ordnance systems upon request. Training will entail (a) launch pad walkdown and (b) launch vehicle familiarization that includes descriptions, locations, and hazards associated with any ordnance. Additionally, Range Users shall provide 8 x 10 inch color photographs of all ordnance items. The photographs should be of sufficient detail to identify individual ordnance items as well as to show the ordnance items in installed configurations on the launch vehicle.

13.4.3.8. For each electrically initiated ordnance device installed on the vehicle and/or payload, the following tools and equipment shall be supplied to EOD in the event of a malfunction that requires render-safe actions or a mishap recovery effort:

13.4.3.8.1. One complete set of shielding caps (current design).

13.4.3.8.2. One set of safety pins.

13.4.3.8.3. Special tools used in installing, removing, and safing the ordnance.

13.4.3.9. Periodic testing of ordnance to verify no sensitivity changes have occurred shall be done, unless it can be shown that the sensitivity with aging is not a credible concern with the specific explosive composition.

13.4.4. Ordnance Operations Pre-Operational Requirements.

13.4.4.1. Pad Safety and Range Users. Before giving concurrence for any ordnance operations to begin, Pad Safety and the Range User shall ensure the following:

13.4.4.1.1. All necessary controls are established.

13.4.4.1.2. Test equipment and the system conform to a configuration approved by Wing Safety.

13.4.4.1.3. For RF susceptible ordnance distance separation requirements, refer to AFI 91-208.

13.4.4.1.4. All ordnance circuit control switches and firing line interrupt switches are in the off (open) position before electrical connection of ordnance and thereafter when pad access is required.

13.4.4.1.5. Personnel and explosives limits are enforced.

13.4.4.1.6. Proper safety clearance zone has been established and cleared before starting the hazardous operation.

13.4.4.1.7. Proper signs are posted, warning lights are operating, barricades are established, and Security/HOS is posted.

13.4.4.1.8. Proper aural warnings and announcements have been made.

13.4.4.1.9. All serial numbers, calibration dates, proof test dates, and other equipment requirements have been verified before operations.

13.4.4.2. Pre-Installation Checkout of Ordnance Items.

13.4.4.2.1. The pre-installation checkout of all ordnance items shall be performed only at Wing Safety approved test facilities.

13.4.4.2.2. Requests to use alternate facilities shall be submitted in writing to Wing Safety.

13.4.4.3. Ordnance No Voltage Checks.

13.4.4.3.1. Before any ordnance electrical connection, no voltage (stray voltage) checks shall be performed on all launch vehicle and payload ordnance electrical connectors.

13.4.4.3.2. These checks shall be made first with power on, then with power off, and include all pin-to-pin and pin-to-case combinations.

13.4.4.3.3. The power on configuration requires the launch vehicle to be powered up in launch configuration. This configuration also requires the payload and upper stage to be powered (along with the launch vehicle) unless the payload does not have any electrical interfaces with the upper stage.

13.4.4.3.4. The power on check shall be performed anytime in the launch.

13.4.4.3.5. The power off configuration requires the launch vehicle and payload to be powered down.

13.4.4.3.6. Power off checks shall be made immediately before ordnance electrical connection.

13.4.4.3.7. If a number of connections must be made in the same general area of the launch vehicle and payload, power off checks shall be made on all of the connectors before ordnance electrical connection. These connections shall be made before any electrical configuration or system changes such as bringing power back up occur.

13.4.4.3.8. Shielding caps shall not be removed from EEDs until electrical connection to the ordnance is to be made.

13.4.4.3.9. The resulting measured signal (current, voltage, power, energy) from a no voltage check shall not be capable of producing a current greater than 20 dB below the

no-fire current of the EED. The no voltage test procedure shall specify the maximum acceptable reading.

13.4.4.3.10. Meters that are used for no voltage checks shall have a valid calibration seal.

13.4.4.3.11. The integrity of the meter and test leads shall be verified before use. Fixed- or facility-test instrumentation that is used in place of portable GSE shall have a procedure that verifies the integrity of the system. A copy of the completed procedure shall be provided to Pad Safety.

13.4.5. Ordnance Operating Requirements.

13.4.5.1. Ordnance operations shall not be conducted when the relative humidity is less than 35%. See **Table 13.5** for additional static charge risk assessment guidance.

Table 13.5. Static Charge Risk Assessment.

A static charge risk assessment should address the extent of low humidity conditions, any plastic or other materials being used such as contamination covers, the propellant/ordnance that is part of the planned task, and the potential of the activity to build up static electricity and create a hazardous electrostatic discharge situation. The risk assessment should also include a discussion of the hazard controls used, such as equipment grounding, personnel grounding, static meter scans, and static dissipation methods. It should be noted that "approved" plastic materials are considered "anti-static" based on testing at 30% humidity; therefore, the use of such materials where the humidity is less than 30% is cause for concern.

13.4.5.2. Ordnance operations shall be conducted in facilities and/or locations specifically approved by the DDESB and/or Wing Safety. Such approvals shall be accomplished by explosives site plans or facility licenses. Wing Safety shall determine the appropriate approval.

13.4.5.3. At the ER, ordnance items shall not be handled, installed, or electrically connected when the passage of an electrical storm is imminent (within 5 nautical miles). Operations Safety Plans shall identify the procedures to be followed for different configurations. At the WR, the guidance provided in **Table 5.1** shall be followed.

13.4.5.4. Ordnance items, particularly initiators, shall be installed and electrically connected as late in processing flow as practical.

13.4.5.5. A rotation test shall be performed on all launch vehicle and/or payload safe and arm (S&A) electro/mechanical devices after installation and erection on the launch pad but before final connection to the ordnance train. This test shall be performed using the launch day system configuration for cycling the S&A. **Note**: Launch day system configuration for performing a rotation test on S&As includes items such as monitor circuitry, power sources, and circuits for cycling the S&A.

13.4.5.6. The ordnance train shall be disconnected from the electro/mechanical S&A output during all checkout operations except during the following circumstances:

13.4.5.6.1. Single complete rotation test (safe to arm to safe).

13.4.5.6.2. Final rotation to arm on the last day of the count.

13.4.5.7. When the electro/mechanical S&A is rotated on the pad, all personnel shall be cleared to an area designated in the OSP.

13.4.5.8. Launch day system configuration for performing a power-on-self-test (POST) on electronic safe-and-arm-devices (ESADs) includes items such as monitor circuitry, power sources, and circuits for cycling the ESAD.

13.4.5.9. The ordnance train shall be disconnected from the ESAD output during all checkout operations, except during final arm on the last day of the count.

13.4.5.10. When the ESAD is armed on the pad, all personnel shall be cleared to an area designated in the OSP.

13.4.5.11. Electromagnetic interference (EMI) testing shall not be conducted with initiators installed on the vehicle or payload without Wing Safety approval.

13.4.6. Laser Initiated Ordnance Operations Personnel Access Criteria.

13.4.6.1. For laser initiated ordnance (LIO) systems, the following personnel access criteria are required:

13.4.6.1.1. For unlimited personnel exposure during LIO tests, the system shall contain three independent verifiable circuit inhibits (dual-fault tolerance).

13.4.6.1.2. For essential personnel exposure during LIO tests, the system shall contain two independent circuit inhibits (single-fault tolerance).

13.4.6.1.3. For no personnel exposure during LIO tests, the system shall contain one circuit inhibit.

13.4.6.2. One inhibit shall be a disconnection of the ordnance train at the LIO or the destruct charge/solid rocket motor igniter (other ordnance end item).

13.5. Explosive Ordnance Disposal.

13.5.1. Rendered Safe Ordnance. All damaged ordnance shall be rendered safe by the AF EOD Team unless otherwise approved by Wing Safety.

13.5.2. Wing Safety Approval for Shipment of Damaged or Rendered Safe Ordnance.

13.5.2.1. Shipments of damaged or rendered safe ordnance from the ranges or the downrange stations shall be approved in writing by Wing Safety.

13.5.2.2. This approval and/or certification shall accompany the shipment.

13.5.2.3. A DOT exception shall normally be obtained by the Range User before AF EOD will release damaged ordnance.

13.6. Ordnance Facilities Operations.

13.6.1. Ordnance items shall not be delivered to, placed in, or processed through facilities or locations on the ranges, or downrange stations unless the facility or area has been approved for such operations by Wing Safety.

13.6.2. Hazardous ordnance deliveries from storage to the Range User shall be coordinated with Wing Safety.

13.6.3. All facilities in which ordnance operations are conducted or stored shall be properly equipped, display the correct explosive safety markings, and otherwise meet the minimum explosives safety standards cited in AFMAN 91-201, DESR 6055.09, sub tier documents, and this publication.

Chapter 14

ELECTRICAL SYSTEMS OPERATIONS

14.1. Electrical Systems Operating Standards and Definitions.

14.1.1. Electrical Systems Operating Standards.

14.1.1.1. ANSI C2, *National Electric Safety Code*, shall be followed in the conduct of electrical systems operations and maintenance.

14.1.1.2. Workplace electrical safety shall be in accordance with NFPA 70E, *Electrical Safety Requirements for Employee Workplaces*, AFI 32-1064, *Electrical Safe Practices*, and AFMAN 91-203 (Chapter 8, *Electrical Safety)*, 29 CFR 1910.269, *Electric Power Generation, Transmission, and Distribution*, and 29 CFR 1910 Subpart S, *Electrical*, as applicable.

14.1.1.3. Maintenance of AF-owned electric power systems shall be in accordance with AFI 32-1062, *Electrical Systems, Power Plants and Generators*. Non AF-owned electric power systems shall be maintained per relevant provisions found in 40 CFR, 29 CFR, National Electrical Code (NEC), NFPA, etc., and manufacturer's written instructions or procedures.

14.1.1.4. Maintenance of grounding systems for AF facilities or facilities regulated by the DDESB shall be in accordance with AFI 32-1065. Maintenance of grounding systems for non-AF facilities shall be IAW relevant provisions found in 7 CFR, 14 CFR, 29 CFR, NEC, NFPA, etc., and manufacturer's written instructions or procedures.

14.1.2. Electrical Equipment Operations in Hazardous (Classified) Locations.

14.1.2.1. Definition of Hazardous (Classified) Locations for Electrical Equipment Operations. Hazardous (Classified) locations are defined in NEC Article 500, *Hazardous (Classified) Locations*

14.1.2.2. Explosives and Propellants Not Covered in NEC Article 500. For range installations, the following paragraphs define the minimum requirements to be applied in the definitions of locations in which explosives, pyrotechnics, or propellants are present or are expected to be present. These requirements shall be followed unless less stringent classifications are justified and approved as part of the design data submittal process. Wing Safety and the Fire Marshal shall approve all potential critical facility hazardous location designations.

14.1.2.2.1. Class I, Division 1. Complete definitions of classified locations are found in NFPA 70. These include the following locations:

14.1.2.2.1.1. Within 25 feet of any vent opening unless the discharge is normally incinerated or scrubbed to nonflammable conditions [less than 25% of Lower Explosive Limit (LEL)]. This distance may be increased if the vent flow rate creates a flammability concern at a distance greater than 25 feet.

14.1.2.2.1.2. Below grade locations in a Class I, Division 2 area.

14.1.2.2.1.3. Locations in which flammable liquids, vapors, or gases may be

present in the air during normal operations.

14.1.2.2.2. Class I, Division 2. Complete definitions of classified locations are found in NFPA 70.

Table 14.1. Class I, Division 2 Hazardous Locations.

Class I, Division 2 usually includes locations where volatile flammable liquids or flammable gases or vapors are used but, in the judgment of Wing Safety and the Fire Marshal, would become hazardous only in case of an accident or of some unusual operating condition. The quantity of flammable material that might escape in case of an accident, the adequacy of ventilating equipment, and the total area involved are all factors that merit consideration in determining the classification and extent of each location.

14.1.2.2.2.1. Piping without valves, checks, meters, and similar devices would not ordinarily introduce a hazardous condition even though used for flammable liquids or gases. Locations used for the storage of flammable liquids or of liquefied or compressed gases in sealed containers would not normally be considered hazardous unless also subject to other hazardous conditions.

14.1.2.2.2.2. As determined by Wing Safety and the Fire Marshal, locations may actively change classification depending on the flammable fluid system activity and configuration. For these types of locations, fixed or permanently installed electrical equipment shall be designed for the worst case hazardous environment.

14.1.2.2.2.3. Portable electrical equipment shall be designed for the worst case hazardous environment in which it will be used. Portable equipment that is not designed for use in a particular hazardous environment is not allowed in that environment.

14.1.2.2.2.4. Class I, Division 2 locations include the following equipment or areas:

14.1.2.2.2.4.1. Storage vessels (including carts and drums). 25 feet horizontally and below to grade and 4 feet vertically above the vessel (25 feet in any direction for hydrogen).

14.1.2.2.2.4.2. Transfer lines. 25 feet horizontally and below to grade and 4 feet above the line (25 feet in any direction for hydrogen).

14.1.2.2.2.4.3. Launch vehicle (liquid fueled vehicle, stage, or payload). 100 foot radius horizontally from and 25 feet vertically above (100 feet for hydrogen) the highest leak or vent source and below the vehicle to grade.

14.1.2.2.2.4.4. Enclosed locations such as rooms, work bays, and launch complex cleanrooms that are used to store and handle flammable and combustible propellants when the concentration of vapors inside the room resulting from a release of all fluids stored and handled equals or exceeds the LEL. The quantity of fluids used in the analysis to determine vapor concentration shall be the maximum amount allowed in the explosives site plan.

14.1.2.2.2.4.5. Locations adjacent to a Class I, Division 1 location into which

ignitable concentrations of gases or vapors might occasionally be communicated, unless communication is prevented by adequate positive pressure ventilation from a source of clean air and effective safeguards against ventilation failure are provided.

14.1.2.2.3. Hazardous Commodity Groups. Hazardous commodities are grouped by similar characteristics.

14.1.2.2.3.1. These fuels shall be considered ignitable regardless of the ambient temperature.

14.1.2.2.3.2. The following fuels shall be categorized as follows:

14.1.2.2.3.2.1. Group B: Liquid or gaseous hydrogen.

14.1.2.2.3.2.2. Group C: Hypergolic fuels such as hydrazine (N2H4), monomethyl hydrazine (MMH), unsymmetrical dimethyl hydrazine (UDMH), Aerozine 50 (A50).

14.1.2.2.3.2.3. Group D: Hydrocarbon fuels (RP and JP).

14.1.2.2.3.2.4. Group D: Exposed Solid Propellants. The atmosphere within 10 feet horizontally and directly overhead of exposed solid propellant shall be classified as a Class I, Division 2 location.

Table 14.2. Exposed Solid Rocket Motors.

Solid rocket motors are considered exposed in the following situations:
1. The motor nozzle is not attached and the aft end of the motor does not have a cover.
2. The motor nozzle is attached but does not have a nozzle plug.
3. The unassembled motor segments do not have front and rear covers.
4. The igniter is removed from the motor and cover is not provided.

14.1.3. Portable Battery Operated Electrical Equipment.

14.1.3.1. Portable Battery Operated Electrical Equipment General Requirements.

14.1.3.1.1. Manual (with a photographer) photography shall not be allowed in a hazardous (Class I, Division 1) environment.

14.1.3.1.2. Only remotely operated, hazard-proofed cameras, equipment and UL listed lighting sources shall be used in a Class I, Division 1 or Division 2 environment.

14.1.3.2. Class I, Division 2 Portable Battery Operated Electrical Equipment Requirements. Requirements for the use of portable battery operated electrical equipment in areas containing solid and liquid propellants that would normally be classified as Class I, Division 2 are listed below:

14.1.3.2.1. Before and during the use of portable battery operated electrical equipment within 100 feet of a flight vehicle propellant system or within 25 feet of propellant storage vessels, the operating environment of the photography equipment shall be verified to be free of hazardous vapors.

14.1.3.2.2. Before bringing portable battery operated electrical equipment into an area, all ordnance installation and/ or connection operations and liquid propellant system operations that affect propellant systems within 100 feet of the equipment shall cease.

14.1.3.2.3. The portable battery operated electrical equipment shall have a UL certification or be purged in accordance with NFPA requirements, meet explosion proof requirements, or demonstrate by analysis to be intrinsically safe. The details of the method of compliance shall be included in a safety assessment report.

14.1.3.2.4. Battery replacement shall occur outside the area.

14.1.3.2.5. Heat-producing, expendable flash bulbs such as flash cubes and sunguns shall not be used with photography equipment.

14.1.3.2.6. The maximum operating temperature of the portable battery operated electrical equipment shall not exceed 80% of the ignition temperature for any vapor that may occur in the operating environment of the equipment.

14.1.3.2.7. Cameras and/or flash attachments to be used inside solid rocket motor bores shall be designed and specified for that particular use.

14.1.3.2.8. Portable battery operated electrical equipment shall not be stored in the Class I, Division 2 area.

14.1.3.2.9. Portable battery operated electrical equipment shall be removed from the Class I, Division 2 area before any operation that could cause an increase in the hazardous environment.

14.2. Electrical Equipment and Systems Test, Inspection, and Maintenance Requirements.

14.2.1. Grounding Systems Tests.

14.2.1.1. Grounding Systems General Test Requirements.

14.2.1.1.1. Grounding system tests for lightning protection, electrical fault protection, and static protection systems shall be performed for all facilities and/or locations (including launch complexes and integrated rocket checkout facilities) used to store, handle, or process ordnance or liquid propellants.

14.2.1.1.2. Facility operators and Range Users shall inspect their portable and movable equipment connections to ground before starting operations each day the equipment is to be used.

14.2.1.2. Grounding Systems Test Plan and Test Frequency Criteria.

14.2.1.2.1. A floor plan layout showing all grounding system test points shall be developed by the facility operator and/or the Range User.

14.2.1.2.2. Lightning and grounding systems shall be tested in accordance with AFI 32-1065.

14.2.1.2.3. Test and inspection results shall be provided to the facility custodian and be available at the facility.

14.2.2. Electrical Equipment Inspection. Before first use or first use after repair, electrical distribution equipment shall be inspected for compliance with NFPA 70 and NFPA 70E.

14.2.3. Electrical Equipment Maintenance and Testing.

14.2.3.1. Electrical equipment shall be maintained in accordance with maintenance plans, manufacturer's directions, reliability centered maintenance strategies, applicable safety codes, etc.

14.2.3.2. Conductors with worn, abraded, or defective insulating material shall be repaired or replaced before the circuit being energized.

14.2.3.3. Electric motors shall be properly maintained and excess dust and oil shall be removed from motors by vacuum cleaning or wiping.

14.2.3.4. Electrical system interior inspection and testing of wiring, power circuit breakers, and protective relaying shall be accomplished in accordance with the NEC.

14.3. Electrical Systems Operating Requirements.

14.3.1. Personnel working with electrical equipment shall comply with NFPA 70E and AFI 32-1064, as applicable. Particular attention shall be given to the following:

14.3.1.1. Personnel working with high voltage equipment shall wear appropriate non-conductive PPE.

14.3.1.2. Supervisors shall be responsible for ensuring that safe working conditions are provided; the work is done in a safe manner; and frequent inspections of equipment, materials, and the work site are conducted.

14.3.1.3. Whenever maintenance or repair work is performed on potentially hazardous energized electrical equipment or circuits, a minimum of two people shall be present (buddy system).

14.3.1.4. Rescue and first aid equipment shall be readily available in areas where electrical maintenance and repair work is being performed.

14.3.1.5. Personnel exposed to energized electrical circuits shall not wear loose clothing, rings, watches, or other metallic objects that can act as conductors of electricity.

14.3.1.6. Weather proof or water-tight test and maintenance equipment used in areas subject to excessive moisture must be listed by a nationally recognized testing laboratory such as UL or FM, or those accredited by OSHA under the Nationally Recognized Testing Laboratory (NRTL) accreditation program, 29 CFR.1910.7, *Definition and Requirements for a Nationally Recognized Testing Laboratory*.

14.3.1.7. Only listed explosion and/or hazard-proofed test and maintenance equipment shall be used in potentially hazardous atmospheres, unless otherwise approved on a case-by-case basis by Wing Safety and documented in a safety assessment report.

14.3.1.8. Before working on capacitor circuitry, external power and short terminals shall be disconnected and discharged to ground.

14.3.1.9. If temporary power lines are required to extend across outside work areas, they shall be protected by a non-conductive cover or elevated so as not to interfere with personnel, vehicles, or equipment traffic.

14.3.1.10. Electrical equipment cords shall have an equipment grounding conductor and shall be grounded when in use. Unless double insulated, the equipment exterior shall be securely bonded and grounded.

14.3.1.11. Dead-end wires shall be completely insulated.

14.3.1.12. Electrical conductors shall be routed to eliminate tripping hazards or contact with energized lines.

14.3.1.13. During repair or maintenance, if panel covers are removed and panels left open to obtain power where none is available, a DANGER HIGH VOLTAGE sign shall be placed next to the open panel and a temporary cover manufactured and installed. When cable connections are made that require the removal of the panel cover, a suitable temporary cover with openings to accommodate the temporary cables shall be used.

14.3.1.14. Insulated fuse pullers shall be used for removal of fuses. Only fuses of proper rating shall be used in circuits. No other material shall be used in place of a fuse.

14.3.1.15. Personnel who are exposed to energized circuits for electrical activities such as troubleshooting, maintaining, or repairing electrical equipment energized with 50 volts or more shall stand on non-conductive matting.

14.3.1.16. Grounding or shorting sticks (or cables) shall be used on potentially hazardous "hot" circuits intending to be de-energized and shall not be removed until repairs are completed.

14.4. Battery Operations. The following requirements apply unless the battery has a UL listing, is intended for public use, and is used in a manner consistent with the UL granted certification:

14.4.1. Battery Operating Standards.

14.4.1.1. An approved means of disposal or transportation to an off-site approved disposal site shall be in place before receipt of the batteries on the ranges.

14.4.1.2. The means of disposal shall be in accordance with DOT and EPA requirements and carry DOT and EPA approvals.

14.4.2. Battery Operations Personnel Requirements.

14.4.2.1. Battery Operations Training and Certification. A training program shall be generated and approved by the Range User for all personnel handling batteries not listed or not intended for public use.

14.4.2.2. Emergency First Aid and PPE Requirements.

14.4.2.2.1. Emergency First Aid.

14.4.2.2.1.1. An emergency eye wash and shower shall be provided in locations where batteries (excluding primary and maintenance-free batteries) are charged and maintained. They shall be installed in accordance with AFMAN 91-203, ANSI/International Safety Equipment Association (ISEA) Z358.1, *Emergency Eyewash and Shower Equipment*, or 29 CFR 1926.411(a)(6), as applicable.

14.4.2.2.1.2. An emergency first aid kit, containing a burn neutralizer shall be provided.

14.4.2.2.2. PPE.

14.4.2.2.2.1. When servicing or handling batteries, PPE shall be provided in accordance with the battery safety data sheet (SDS), AFMAN 91-203, or ANSI/ISEA Z87.1, *Occupational and Educational Personal Eye and Face Protection Devices*, as applicable.

14.4.2.2.2.2. In addition, electrolyte/chemical spill containment/adsorption material shall be provided in the close vicinity of the battery(s) for use by operating personnel in the event of an electrolyte spill.

14.4.3. Battery Procedures.

14.4.3.1. Procedures for battery receipt, transportation, checkout, handling, installation, safing, packing, storage, and disposal shall be developed and submitted to Wing Safety for review and approval.

14.4.3.2. Specific safing operations of batteries shall be in battery handling and checkout procedures.

14.4.3.3. Battery handling and checkout procedures shall include the following topics:

14.4.3.3.1. A list of proper handling equipment.

14.4.3.3.2. Identification of specific personnel qualified to safe batteries if in an unsafe condition.

14.4.3.3.3. Identification of the exact location of the storage site for depleted or unsafe batteries.

14.4.4. Lithium Batteries Special Requirements.

14.4.4.1. General Information. Lithium batteries are thermal batteries, also called molten salt batteries. Lithium batteries are different from lithium-ion batteries, even though they both contain the element lithium. Lithium batteries are primary cell batteries, that is, batteries where the electrochemical reaction is not reversible.

14.4.4.2. Wing Safety shall approve temporary lithium battery storage and handling facilities. These facilities shall be used only for lithium batteries and shall not be used for other purposes. Lithium batteries shall not be stored permanently on the ranges.

14.4.4.3. The Range User shall provide certification of lithium battery(s) conforming to all safety critical steps and processes agreed to by Wing Safety during the battery development phase.

14.4.4.4. Before delivery of lithium batteries to the ranges, an approved off-site disposal contract shall be in place for the batteries in any condition.

14.4.5. Lithium Ion Battery/Cell Special Requirements.

14.4.5.1. Storage of the batteries (when not installed in GSE or the spacecraft) shall be in approved battery storage locations.

14.4.5.2. Battery and cells shall be treated as always having a voltage potential, therefore, connection or disconnection of a battery shall be considered an electrical personnel hazard and a ‘spark’ potential.

14.4.5.3. Range users shall have an operational plan for battery/cell handling that includes emergency contingency operations for physical abuse incident and battery installation/removal.

14.4.5.4. Support equipment (ground or airborne) shall be verified to operate correctly prior to first operational use on the range, including all fault tolerant devices or subsystems, prior to connecting battery. Verification shall include inducing overvoltage/undervoltage/temperature extremes to the monitoring devices as intended when in use prior to connecting of the battery.

14.4.5.5. On-base transportation to the launch site should meet DOT requirements. Evidence of compliance with DOT requirements for transportation shall be provided.

14.4.5.6. External heating sources for battery/cell maintenance shall be dual fault tolerant and provide feedback monitoring capability or be analyzed for failure modes on cell/battery heating.

14.4.5.7. Charging and Discharging.

14.4.5.7.1. GSE/Flight hardware used for charging (shall prevent each cell from exceeding 4.4 volts) and discharging (driving cells to less than 0 volts) shall be dual fault tolerant. Individual cells that have an internal design which provides high rate discharge protection (e.g., positive temperature coefficient devices and internal fuses) may be considered to already have one inhibit. The GSE shall provide at a minimum one inhibit for charging/discharging control.

14.4.5.7.2. Discharging shall not take place below -20° C or above 60° C.

14.4.5.8. Battery/Cell Monitoring.

14.4.5.8.1. Battery/cell monitoring and recording is required during charging and discharging.

14.4.5.8.2. Voltages shall be recorded at least every minute for charge rates that exceed the battery capacity (e.g., if capacity is 1 amp-hour and charger is supplying greater than 1 amp of current). Record voltages every 10 seconds for charge rates between 1 and 2 times battery capacity. Record voltages every second for charge rates that exceed 2 times battery capacity.

14.4.5.8.3. Charging data shall be reviewed for anomalies and verification of voltage limits.

14.4.5.8.4. Provisions shall be made for charging, monitoring, and recording each cell/cell pack with electronic ground support equipment that prevents high heat, sparking and high charge/discharge current rates.

14.4.6. Battery Maintenance, Storage, and Operations.

14.4.6.1. Rechargeable storage batteries and batteries requiring activation at the ranges shall be handled only in Wing Safety approved areas.

14.4.6.2. Separate areas shall be provided for servicing of batteries that have incompatible electrolytic solutions, e.g., acid and alkaline batteries.

Chapter 15

MOTOR VEHICLE OPERATIONS

15.1. Motor Vehicle Operating Standards.

15.1.1. Motor vehicles that do not meet DOT public transportation requirements shall not be permitted to transport hazardous materials on the range unless the vehicle is covered by a formal DOT exemption and is approved by Wing Safety.

15.1.2. Special-purpose trailers for range use only shall conform to operational requirements in AFMAN 91-201 and DESR 6055.09.

15.1.3. All vehicle operations shall comply with federal and state laws, and Air Force and range regulations, including, but not limited to, the following criteria:

15.1.3.1. Proper licensing of operators.

15.1.3.2. The use of vehicle restraint devices such as seat belts.

15.1.3.3. Restrictions on wearing headphones or ear speaker type radios while operating a vehicle.

15.1.3.4. The use of spotters when backing with restricted rear vision vehicles.

15.2. Motor Vehicle Operating Requirements.

15.2.1. Operator Instructions.

15.2.1.1. Maneuvering in the vicinity of hazardous commodities requires the use of a spotter.

15.2.1.2. When backing, chocks shall be used to prevent contact.

15.2.2. Indoor Operations. Gasoline or diesel vehicle operations in AF facilities or where government personnel may be exposed shall require the approval of the installation Bioenvironmental Engineer.

15.2.3. Ordnance and Propellant Area Parking.

15.2.3.1. General Parking Requirements.

15.2.3.1.1. Vehicle parking in areas sited and used for ordnance or propellants shall be IAW the applicable OSP.

15.2.3.1.2. These OSPs shall be developed using the criteria found in this document and shall also take into consideration the criteria from AFMAN 91-201 and DESR 6055.09.

15.2.3.2. General Parking Restrictions.

15.2.3.2.1. Designated parking areas shall be used.

15.2.3.2.2. Privately owned vehicles shall not be parked within the fenced-in area of hazardous processing facilities.

15.2.3.2.3. No vehicle shall be parked within 25 feet of lines containing liquid propellants.

15.2.3.2.4. No vehicle shall be parked within 50 feet of storage tanks containing liquid propellants.

15.2.3.2.5. When required, delivery vehicles are exempt from the preceding requirements during loading and off-loading but they shall be removed immediately afterwards.

15.2.3.2.6. While parked, the parking brake shall be engaged and wheels shall be chocked if the vehicle could inadvertently roll and cause damage.

15.2.3.3. Restricted Parking Areas. All non-essential vehicles are prohibited from parking in the following areas under the following conditions:

15.2.3.3.1. Within the flight hazard area (FHA) once the FHA has been established.

15.2.3.3.2. In the blast danger area (BDA) during wet dress rehearsal (cryogen tanking).

15.2.3.3.3. Within the FHA during core vehicle tanking (other than cryogens that are tanked) after the BDA/FHA is established.

15.2.3.3.4. Within the launch complex fence line during fueled spacecraft/upper stage mating operations.

15.2.4. Internal Combustion Engine Vehicles. Motor vehicles or equipment having internal combustion engines shall be equipped with spark arresters and carburetor flame arresters as applicable:

15.2.4.1. When transporting explosives that have exposed grain, scrap, waste or items visibly contaminated with explosives.

15.2.4.2. When operating within the control area during propellant transfer operations or continuously within propellant off-loading and/or propellant storage areas.

15.2.5. Hazardous Commodities Vehicle Transportation Standards. Vehicles transporting hazardous commodities shall meet DOT and DoD regulations (for example, AFMAN 91-201 and DESR 6055.09) unless exempted or approved for use by Wing Safety.

15.2.6. Hazardous Location Restrictions. Vehicles shall not be operated in locations classified as hazardous by NEC Article 500 without Wing Safety approval.

15.3. Special-Purpose Trailers Used to Transport Critical or Hazardous Loads.

15.3.1. Periodic Tests. A periodic road/load test at 100% rated load shall be performed at least every 4 years on trailers used to transport hazardous hardware, with single failure point (SFP) weld inspection limited to surface NDE. Unless otherwise agreed to by Wing Safety, a road/load test shall also be performed after a trailer has experienced structural modification or repair.

15.3.2. Data Requirements. Recurring data requirements shall be submitted in accordance with AFSPCMAN 91-710 Volume 3, Attachment 2. Maintenance records shall be maintained by the operator and made available upon request.

Chapter 16

CONVOY OPERATIONS

16.1. General.

16.1.1. A convoy is required for all transportation considered hazardous operations unless exempted by Wing Safety. Convoy operations shall be conducted in accordance with federal, state, and any wing-specific regulations or policy memorandums. **Note**: Examples may include oversized loads where the load is larger than 12 feet in width, 13.5 feet in height, or 55 feet in length; transport of hypergolic fuels in non-DOT approved containers; transport operations that go against flow of traffic or that take up more than one lane.

16.1.2. AF personnel operating government motor vehicles as part of a convoy shall comply with the requirements in AFMAN 24-306, *Operation of AF Government Motor Vehicles*.

16.2. Convoy Operations Procedures. A procedure for hazardous convoy operations shall be submitted to Wing Safety for review and approval. This procedure should include a description of a pre-route survey.

16.3. Convoy Operations Requirements. The Range User and/or the agencies responsible for the transportation of a hazardous load shall ensure the following items are performed:

16.3.1. The hazardous load to be transported shall be identified.

16.3.2. The convoy shall be scheduled through CCAFS Cape Support (321-853-5211) at the ER and through Range Scheduling (805-606-8825) at the WR.

16.3.3. A convoy commander shall be designated.

16.3.4. When transporting hazardous loads, the transfer route shall be chosen to minimize exposure to populated areas and critical facilities. **Note**: Transfer should occur during off-peak traffic and population hours.

16.3.5. The selected route shall be identified and the following items noted:

16.3.5.1. Horizontal and vertical clearances.

16.3.5.2. The hazardous commodity transported.

16.3.5.3. Population along the route.

16.3.5.4. Traffic that may be encountered.

16.3.5.5. Condition of surface being traveled upon.

16.3.5.6. Distance of route.

16.3.6. Radio contact shall be maintained with the convoy commander for all elements of the convoy.

16.3.7. At a minimum, the following items of equipment are required:

16.3.7.1. Flashlights if transport occurs during periods of darkness.

16.3.7.2. Emergency apparatus such as fire extinguishing equipment, reflectors, and flares.

16.3.8. Proper environmental health required by the commodity transported shall be ensured.

16.3.9. When required by the transportation plan, areas shall be cordoned off.

16.3.10. Emergency actions shall be taken to secure the item being transported in the event of a mishap.

16.3.11. A pre-operational check of the loaded vehicle and trailer shall be conducted. **Note**: For example, the prescribed tire air pressure should be verified.

16.3.12. A convoy commander pre-departure briefing guide and requirements shall be prepared and conducted. The briefing guide includes such information as hazards, communication checks, and stop points.

Chapter 17

LAUNCH OPERATIONS

17.1. Launch Countdown.

17.1.1. Launch Countdown Pre-Operational Requirements. Wing Safety shall ensure the following launch countdown pre-operational functions are performed:

17.1.1.1. Within 21 calendar days of F-0 day, monitoring and verifying FTS S&A and exploding bridgewire (EBW)/explosive foil initiator (EFI) detonator electromechanical checks at a Wing Safety approved location.

17.1.1.2. If applicable, ensuring command receivers are not turned on any time FTS ordnance is electrically connected unless Range Control Officer concurrence has been given to Wing Safety.

17.1.1.3. Monitoring and verifying no-voltage checks, installation, and hookup of FTS or any other hazardous ordnance.

17.1.1.4. Verifying that all emergency support functions and subject matter experts are in the Launch Emergency Operations Center (LEOC) for each launch.

17.1.2. Launch Countdown General Requirements. The Pad Safety Officer (PSO) shall perform the following launch countdown general functions:

17.1.2.1. Verifying permanent firefighting and cooling water systems are operating properly and that adequate water, at the correct operating pressure and flow rate, is available until after launch or until the test is scrubbed and propellants have been detanked.

17.1.2.2. Verifying RF silence, as required.

17.1.2.3. Monitoring and verifying FTS electro/mechanical S&A rotation on the pad.

17.1.2.4. Monitoring and verifying FTS end-to-end and other FTS checkouts.

17.1.2.5. Immediately notifying Wing Safety of any FTS system, subsystem, or component failure, discrepancy, or parameter violation.

17.1.2.6. At the ER, conducting holdfire and launch enable/disable checks.

17.1.2.7. Verifying removal of the FTS and ignition electro/mechanical S&A safing pin and EBW/EFI circuitry safing plug and clearing the flight hazard area before launch.

17.1.2.8. Verifying reinsertion of the FTS and ignition electro/mechanical S&A safing pin and EBW/EFI circuitry safing plug in the event of a scrub as directed by Wing Safety.

17.1.2.9. Verifying reinsertion of any hazardous ordnance safing devices in the event of a scrub as directed by Wing Safety.

17.1.2.10. Calling a hold during a test or actual launch countdown or preventing further progress of a test when, in the opinion of the PSO, such action is necessary in the interest of safety.

17.1.2.11. Clearing the flight hazard area before launch.

17.1.2.12. Verifying no-fire voltage condition of electronic safe-and-arm-device firing units (ESAD-FU) in the event of a scrub, as directed by Wing Safety.

17.1.3. Launch Countdown Operations.

17.1.3.1. At the ER, to ensure proper operation, the holdfire and firing line interrupt capability shall be checked out at a mutually agreed time as close to launch as practical with Pad Safety present, with results of the checkout reported by Pad Safety Console in the Launch Control Center, or on board ship during the launch countdown. **Note:** The term 'Pad Safety Console (PSC)' has also been known in the past as 'Operations Safety Console (OSC)'; the terms shall be considered interchangeable.

17.1.3.2. The PSO shall implement responsibilities identified in the Wing Safety approved countdown procedures.

17.1.3.3. The PSO shall initiate a holdfire when safety constraints or emergency situations dictate.

17.2. Launch Emergency Operations Center (LEOC)/Launch Support Team (LST) Operations.

17.2.1. LEOC/LST Duties and Responsibilities. Duties and responsibilities of the LEOC/LST are found in Wing-level launch support and emergency response plans (e.g., the Installation Emergency Management Plan).

17.2.2. LEOC/LST Operations Requirements.

17.2.2.1. During major launch operations, the LEOC/LST shall be available for immediate response to a launch vehicle and/or payload impact on the ranges, KSC, or the public domain.

17.2.2.2. The Range User shall have the required vehicle launch crew necessary to support launch operations at least 90 minutes before T-0.

17.2.2.3. Crews for securing the complex after a normal launch shall not be located in the same area as the LEOC/LST. These crews shall be located so as not to interfere with LEOC/LST operations.

17.3. Post-Launch Operations.

17.3.1. Immediately after a launch, the Range User, Pad Safety, and the Fire Department shall inspect the pad, per local procedures, for personnel hazards such as contamination, spills, exposed wiring, structural or facility damage, damaged or leaking propellant or pressure systems, low oxygen content in enclosed areas, and fires.

17.3.2. Pad Safety shall coordinate with the Range User to determine when it is safe to open the pad for normal work.

17.3.3. Pad Safety shall direct Security/HOS to adjust or lift roadblocks as warranted by existing conditions.

17.3.4. Fire, medical, and pumping station support shall be released when no longer needed and normal security measures are instituted.

17.4. Launch Abort and Misfire/Hangfire Operations.

17.4.1. General. Any failure to launch or ignite properly shall be treated as a hangfire until 30 minutes has elapsed or it can be determined that a misfire has occurred. The 30-minute waiting period is not applicable to ballistic vehicles at the WR in cases where it is dictated by T.O.s.

17.4.2. Common Abort or Misfire/Hangfire Operations.

17.4.2.1. The flight safety system (FSS) shall remain configured in a manner that will enable destruct action to be taken if necessary until Pad Safety (ER)/Flight Safety Project Officer (FSPO) (WR) has verified and reported that the launch vehicle is no longer in a launch configuration.

17.4.2.2. In the event of a launch abort or misfire or following expiration of the 30-minute waiting period in the case of a hangfire with solid propellant stages or a solid propellant starter devices, the PSO shall perform the following activities: **Note**: For an autonomous flight safety system, some of the below tasks may need to be tailored depending on implementation choices that affect requirements for a Mission Flight Control Officer (MFCO), command receivers, and command destruct sites.

17.4.2.2.1. Electro/mechanical S&A.

17.4.2.2.1.1. Ensure the ignition firing circuit has been disabled.

17.4.2.2.1.2. Allow rotation of the FTS S&A to safe with approval of the MFCO.

17.4.2.2.1.3. Verify to the MFCO that the FTS S&A devices are in the safe position.

17.4.2.2.1.4. Verify to the MFCO that the safing devices are reinstalled (where physically feasible and applicable).

17.4.2.2.1.5. Allow the command receivers to be turned off after coordination with the MFCO.

17.4.2.2.2. ESAD-FU.

17.4.2.2.2.1. Ensure the ignition firing circuit has been disabled.

17.4.2.2.2.2. Power off the ESAD-FUs to safe with approval of the MFCO.

17.4.2.2.2.3. Verify to the MFCO that the ESAD-FU devices are powered off and the capacitor is discharged below the allowable no-fire voltage. **Note**: In certain cases, specific fail-safe strategies may require additional conditions to be met prior to powering off the ESAD-FU. Ensure that any other ESAD-FU fail-safe conditions have been met prior to powering off the ESAD-FU.

17.4.2.2.2.4. Allow the command receivers to be turned off after coordination with the MFCO.

17.4.2.2.2.5. Verify to the MFCO that the safing of the ESAD-FU and command receiver devices is complete (where physically feasible and applicable).

17.4.2.2.3. Wing Safety shall make a launch complex inspection in conjunction with the Range User and allow access to the launch complex for work when it is safe to do so.

17.4.2.2.4. Adjust or lift roadblocks as required.

17.4.2.2.5. When no further launch attempt is contemplated, verify that hazardous ordnance items are disconnected electrically and shielded and, if required, removed for return to the storage area.

17.4.2.2.6. Request support by the EOD team when disarming of ordnance systems or components cannot be accomplished using normal methods.

17.4.2.2.7. If necessary, the EOD team shall initiate render-safe procedures.

17.4.3. Launch Vehicles Using Liquid Propellant Stages Abort or Misfire/Hangfire Operations.

17.4.3.1. In the event of a launch abort or misfire/hangfire, the Range User shall depressurize the vehicle propellant tanks and pressure systems to a safe, static condition.

17.4.3.2. Pad Safety shall monitor the detanking of propellants where applicable.

17.4.4. Launch Vehicles Using Solid Propellant Stages or Solid Propellant Starting Devices Abort or Misfire/Hangfire Operations.

17.4.4.1. In the event of a hangfire, Pad Safety (ER)/FSPO (WR), the Range User, and the Range Operations Squadron shall ensure the FSS remains configured in a manner that will enable destruct action, if necessary, in the event of unscheduled launch. **Note**: The waiting period in this configuration is a minimum of 30 minutes during which time the FHA shall remain cleared.

17.4.4.2. For vehicles using solid propellant stages or solid propellant starting devices, Pad Safety shall restrict access to the pad until it can be verified that power did not reach the initiator (misfire) or it is assumed that power did reach the initiator (hangfire) and a 30-minute waiting period has elapsed.

17.5. Range User Launch Operations Responsibilities.

17.5.1. Launch Operations Procedures. At a minimum, Range User prepared procedures for the launch countdown and prelaunch count shall contain the following Wing Safety functions for the specific launch vehicle and payload systems:

17.5.1.1. Monitoring and verifying no-voltage checks, installation, and hookup of FTS and any other hazardous ordnance.

17.5.1.2. Approval to start ordnance tasks.

17.5.1.3. Approval to start propellant transfer and launch vehicle tanking.

17.5.1.4. Approval to start pressurization.

17.5.1.5. Monitoring and verifying FTS checkout.

17.5.1.6. At the ER, conducting holdfire and launch enable/disable checks.

17.5.2. Range User Support of LEOC/LST. The Range User shall provide launch crew personnel required to support the LEOC or LST Chief at the identified site at least 90 minutes before T-0. Crews for securing the complex after a normal launch shall not be located in the same area as the LEOC/LST. These crews shall be located so as to not interfere with LEOC/LST operations.

Chapter 18

SOLID ROCKET MOTORS AND ROCKET MOTOR SEGMENTS OPERATIONS

18.1. General Operations Requirements. In addition to the requirements of **Chapter 3** and **Chapter 13**, the Range User shall comply with the following requirements for operations involving solid rocket motors and rocket motor segments.

18.2. Transportation and Handling Requirements.

18.2.1. Operational hazard analyses should be performed for all aspects of solid rocket segment and/or motor handling and buildup.

18.2.2. Solid rocket motor segments/motors transported on trailers or railroad cars shall be properly restrained to the trailer or railroad car support structures to minimize possibility of loss of load in an accident scenario.

18.2.3. For solid rocket motor/segment transporting trailers or railroad cars that use internal combustion engine powered generators for the environmental control units, gasoline or liquid propane gas powered engines shall not be used. If internal combustion engine generator equipped trailers or railroad cars loaded with solid rocket motors/segments are brought inside processing facilities, care shall be taken to minimize the quantity of fuel in the generator tanks. The fuel tanks shall be reinforced and equipped with a protective shield to minimize possibility of tank rupture and fuel ignition during transport. An insulation barrier shall be provided between the environmental control unit and the solid rocket motor or motor segment to protect the motor from heat or possible fuel fire. **Note:** Diesel powered generators are preferred due to much lower flammability of the diesel fuel.

18.2.4. If forced air heaters are used for environmental control on covered railroad cars or trailers transporting solid rocket motors/segments, liquid propane gas heaters or gasoline heaters shall not be used. The effects of heater failures on the trailer/railroad car shall be analyzed and reported in an analysis as required by AFSPCMAN 91-710 Volume 3, Chapter 18.

18.2.5. Canvas covers for solid rocket motor/segment transporting trailers or railroad cars shall not be used. If their use cannot be avoided, the rubberized canvas material shall be subjected to triboelectric testing and meet the test requirements for plastic materials used in solid rocket motor/segment processing. An operational hazard analysis shall be performed to demonstrate that under the worst case conditions (for example, broken or loose canvas tie downs and canvas flapping and rubbing on the segment or motor case), not enough static can be accumulated to cause a catastrophic event, such as propellant ignition).

18.2.6. Solid rocket motor/segment transport trailers or railroad cars containing solid rocket motors/segments shall be secured to prevent inadvertent motion when parked; in other words, brakes set and wheels chocked.

18.2.7. Locomotives and tractors that transport solid rocket motor/segment cars and trailers shall be removed from processing facilities as soon as possible.

18.2.8. If air pallets are used for transport of solid rocket motors/segments inside processing facilities, the structure of the air pallet shall be rigid enough to minimize elastic deformation of the pallet under load and, thus, minimize stresses transferred to the solid rocket

motor/segment. **Note**: Due to the strict requirements for floor surfaces required for such air pallet operation and the fact that such surfaces are easily damaged, extensive use of air pallets for solid rocket motor/segment transport is not recommended.

18.3. Inspection Requirements.

18.3.1. Periodic NDE should be performed for all aerospace ground equipment used to handle rocket motors and segments, in accordance with NDE plans.

18.3.2. If wetting of a solid rocket motor/segment with water is required for ultrasonic inspections, adequate water intrusion barriers shall be provided to prevent the propellant from getting wet. **Note**: The wetting of propellant surfaces with water could result in precipitation of ammonium perchlorate crystals on the propellant surface and possibly increase propellant sensitivity.

18.3.3. Solid rocket motors/segments with graphite epoxy casings, which are very sensitive to external damage, shall be visually inspected for case damage at each major stage of processing and upon arrival at the launch pad. **Note**: Protective measures, such as blankets, should be used to shield solid rocket motors/segments from damage during transport and storage where practical.

18.3.4. For igniter uncrating and inspection operations of separately shipped igniters, corrosion protection coatings shall be removed from the igniter metal flange before special lifting adapters are attached to the flange. **Note**: Failure to remove the coatings may cause the lifting adapter to stick to the igniter flange, possibly resulting in the igniter being lifted after the adaptor bolts have been removed when attempting to remove the unsecured adaptor. This may result in the igniter being raised and dropped into its crate.

18.3.5. Extreme care shall be taken when inspecting and handling igniters. **Note**: Igniter propellant contains a higher percentage of oxidizer than regular motor propellant and is very energetic.

18.3.6. Fixtures using cradles for the storage and handling of solid rocket motors/segments shall be inspected for cleanliness and the absence of any objects that could damage the sensitive solid rocket motor/segment cases when they are lowered into the cradles.

18.3.7. For open grain inspections, wrist stats shall be used within 5 feet of the open grain.

18.4. Processing and Handling Requirements.

18.4.1. General Requirements.

18.4.1.1. Pathfinder operations using size and weight representative of inert solid rocket motors/ segments shall be conducted before live/operational solid rocket motor/segment processing operations are conducted.

18.4.1.2. For solid rocket motor/segment lifting operations, main processing facility overhead doors shall be kept at least partially open, weather permitting, to provide additional exit routes, unless the doors are required to be closed to reduce exposure of additional personnel.

18.4.1.3. If rotating fixtures are used to rotate solid rocket motors/segments (for purposes of cork installation, for example), the rotating fixture cradles shall be equipped with a

means to restrain the solid rocket motors/segments during rotation. **Note**: A hydraulic powered rotating mechanism is preferred.

18.4.1.4. If internal combustion powered vehicles, such as forklifts or man lifts, are required for support of solid rocket motor/segment handling operations and are operated in close proximity of the solid rocket motors/segments, gasoline and liquid propane gas powered equipment shall not be used. The equipment shall be located no less than 25 feet from the solid rocket motors/segments and at least 100 feet away when being refueled. If a forklift is used as a hoist in close proximity of a solid rocket motor/segment OSHA approved fork lifting adapters shall be used. **Note**: Battery powered equipment is preferred.

18.4.1.5. All tapes and plastic materials used around open grain areas of a solid rocket motor/segment shall be subjected to triboelectric and flammability testing and be listed on NASA-STD-6001, *Flammability, Odor, Offgassing, and Compatibility Requirements and Test Procedures for Materials in Environments that Support Combustion*, and/or Kennedy Technical Instruction (KTI)-5212, *Material Selection List for Plastic Films, Foams, and Adhesive Tapes*.

18.4.1.6. For joint cleaning operations, where solid rocket motors/segments are placed on elevated adaptors, extreme care shall be taken to ensure that such adaptors are properly attached to the support structures. If solid rocket motors/segments are suspended from a crane during such operations, at least 50% of the solid rocket motor/segment weight shall be supported by the crane.

18.4.1.7. An operations safety plan shall be written for each solid rocket motor/segment processing facility. This plan shall define the required clearance areas for all hazardous operations.

18.4.1.8. Solid rocket motor/segment processing facilities shall be kept clean and uncluttered at all times. Separate facilities for storage of support equipment and receiving and uncrating of flight hardware shall be used, as necessary, to maintain unobstructed access to exits at all times. Shipping containers shall be removed from the processing facility immediately as soon as possible after unpacking the hardware.

18.4.1.9. Solid rocket motor/segment processing facilities shall not be used for storage of ground support equipment or flight hardware belonging to other programs or not related or not needed for the solid rocket motor/segment handling operations.

18.4.1.10. Solid rocket motor/segment processing and storage facilities containing ordnance shall not be used as emergency garage facilities for motor vehicles; for example, storing these vehicles next to stored solid rocket motors/segments before an earthquake, tropical storm, or a hurricane.

18.4.1.11. An unobstructed access to at least two exits in the processing facility shall be maintained at all times during solid rocket motor/segment handling operations.

18.4.1.12. Breakout gates shall be provided in the processing facility perimeter fence to enable speedy evacuation in case of emergency. The number and location of the gates shall be based on worst case conditions (facility population, facility configuration, and meteorological conditions) and shall be approved by Wing Safety.

18.4.1.13. Waste collection dumpsters shall not be located inside solid rocket motor/segment processing and storage facilities.

18.4.1.14. Combustible materials, such as lumber and dunnage used in support of rocket segment/ motor handling operations, shall be treated with flame retardant paint. Bulk stacks of combustible materials shall be no closer than 100 feet from the solid rocket motors/segments and removed from the facility as soon as possible.

18.4.1.15. Flammable materials needed for processing of solid rocket motors/segments shall be stored in Wing Safety approved lockers and used in minimum necessary quantities around the solid rocket motors/segments. Waste, such as degreaser or oil soaked rags, shall be placed in closed Wing Safety approved metal containers and the containers shall be emptied at the end of every shift. Due to the possibility of spontaneous fires, contaminated waste material shall be removed from the facility as soon as possible and, in no case, left unattended overnight. Waste collection metal containers shall be placed no closer than 25 feet from the solid rocket motor segments/motors.

18.4.1.16. Complete solid rocket motors that are capable of unguided flight upon ignition (as determined by analysis) that are stored vertically or horizontally shall be restrained or thrust termination devices shall be provided to prevent fly-aways. **Note**: Vertical storage of built-up rocket motors is undesirable unless they are mated to the core vehicle.

18.4.1.17. When built-up solid rocket motors must be stored vertically in the stands, provisions shall be made to protect the motor nozzles from external facility fires. The motors shall be restrained in the stands to ensure that they will not topple in case of an earthquake, tornado, high winds, or a hurricane impacting the facility, or some other mishap in the facility. **Note**: For example, a separation wall could be built between the processing area and the stand.

18.4.1.18. If desiccant cartridges are used in the stored solid rocket motor/segment covers, provisions shall be made for their periodic replacement.

18.4.1.19. For large vertically stacked solid rocket motor igniter installations, the bore opening on top of the motor shall be guarded to prevent personnel from falling into the motor bore.

18.4.2. Grounding and Open Grain Work.

18.4.2.1. All solid rocket motors/segments and built-up motors shall be grounded at all times. When solid rocket motor segments and built-up motors are in storage stands or fixtures, the resistance to ground shall not exceed 10 ohms. When moving the solid rocket motors/segments, make-before-break technique shall be applied. The new ground wire shall be connected to ground and the resistance verified.

18.4.2.2. If a solid rocket motor/segment and/or built-up motor is found ungrounded for any reason (for example, the grounding wire is disconnected), the ground wire shall be immediately reconnected, the ground verified, and a static meter shall be used to measure the voltage on the case surface. The voltage shall be 1,000 V or less before the solid rocket motor/segment can be worked on or moved from its storage stand or fixture. Grounding shall be accomplished in the manner that attaches the grounding wire to the ordnance item first and then to the facility ground (away from the ordnance) last.

18.4.2.3. For open grain work, wriststats shall be used within 5 feet of the open grain. Electrically powered equipment used within 10 feet of the open grain shall be explosion proof or designed to be intrinsically safe.

18.4.3. Crane Operations.

18.4.3.1. If lifting of rocket motors/segments with cranes is required, the height of such lifts shall be kept to the absolute required minimum and below the propellant ignition threshold. For those lifts where the lift height must exceed the propellant ignition threshold, detailed justification data shall be submitted to Wing Safety for review and approval.

18.4.3.2. A clear area shall be established around each lift to ensure that the solid rocket motor/segment will not impact a sharp object in case of crane or rigging failure. **Note**: Sharp object impalement may reduce the ignition threshold of propellant by a factor of two.

18.4.3.3. Lifting of solid rocket motors/segments over other motors or flight hardware shall be avoided except where necessary for stacking or storing operations.

18.4.3.4. The number of spotters and personnel required to support the solid rocket motor/segment lift operations shall be kept to the absolute minimum required. Remote cameras or similar devices shall be used in locations where NFPA 101, *Life Safety Code*, requirements for evacuation of personnel from high hazard facilities cannot be met.

18.4.3.5. Proposed breakover operations of solid rocket motors/segments shall be submitted to Wing Safety with substantiation that there is no other practical means to accomplish the task. The data shall illustrate how risks are minimized and managed. A detailed operational hazard analysis is required. **Note**: The cranes shall be designed for breakover operations IAW the requirements of AFSPCMAN 91-710 Volume 3 and the heights of the lift kept to the absolute minimum required.

18.4.3.6. Crane hoisting operations that involve lifting large stacked solid rocket motors are not recommended due to the extreme hazards involved. A detailed operational hazard analysis is required. Lifting heights shall be kept to the absolute minimum required. **Note**: Stacking on a transporter or on the launch pad is always a safer alternative.

18.4.3.7. If a crane operational fault occurs during a solid rocket motor/segment lifting operation that leaves the load suspended, the crane power shall not be recycled to clear the fault until crane troubleshooting determines the nature of the fault.

BRIAN W. KABAT, Colonel, USAF
Director of Safety

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

See SPFCMAN 91-710 Vol 7, *Range Safety User Requirements Manual Volume 7 - Glossary of References, Abbreviations and Acronyms, and Terms*

Prescribed Forms

See SPFCMAN 91-710 Vol 7, *Range Safety User Requirements Manual Volume 7 - Glossary of References, Abbreviations and Acronyms, and Terms*

Adopted Forms

See SPFCMAN 91-710 Vol 7, *Range Safety User Requirements Manual Volume 7 - Glossary of References, Abbreviations and Acronyms, and Terms*

Abbreviations and Acronyms

See SPFCMAN 91-710 Vol 7, *Range Safety User Requirements Manual Volume 7 - Glossary of References, Abbreviations and Acronyms, and Terms*

Terms

See SPFCMAN 91-710 Vol 7, *Range Safety User Requirements Manual Volume 7 - Glossary of References, Abbreviations and Acronyms, and Terms*

Attachment 2

GROUND OPERATIONS PLAN

A2.1. Introduction.

A2.1.1. **Purpose.** The Ground Operations Plan (GOP) provides a detailed description of the hazardous and safety critical operations associated with a missile system and its associated ground support equipment. It is one of the elements from which Missile Systems Prelaunch Safety approval is obtained from the ranges along with the Missile Systems Prelaunch Safety Package (MSPSP) required in AFSPCMAN 91-710 Volume 3.

A2.1.2. **Content.** This attachment contains the content preparation instructions for the data generated by the requirements delineated in this volume.

A2.1.3. **Applicability.** The requirements in this attachment are applicable to all ground, launch facility, launch and reusable launch vehicles, and spacecraft systems.

A2.1.4. **Submittal Process.** The GOP submittal periods are delineated in paragraph **4.1**.

A2.1.5. **Final Approval.** The GOP shall be approved by Wing Safety as delineated in paragraphs **4.1** and **4.1.4**.

A2.2. Preparation Instructions.

A2.2.1. **Content.** The GOP contains a description of planned operations (including backout and pathfinder operations) and the associated hazard analysis of those operations. Where applicable, previously approved documentation may be referenced throughout the package.

A2.2.2. **Format.** Range User format is acceptable provided the information described below is provided.

A2.2.2.1. **Table of Contents and Glossary.** The GOP shall contain a table of contents and a glossary.

A2.2.2.2. I**ntroduction.** The "introduction" section shall address the purpose and scope of the GOP

A2.2.2.3. **General Description.** The "general description" section shall present an overview of the system and the general processing flow as a prologue to the hazardous and safety critical operation descriptions. The following items are included in this section:

A2.2.2.3.1. General flow of system integration and testing.

A2.2.2.3.2. Facilities to be used.

A2.2.2.3.3. Generic timeline with sufficient granularity to identify the major hazardous and/or FTS operations.

A2.2.2.4. **Ground Operations.** The "ground operations" section shall identify the ground processing flow including all hazardous and safety critical operations. The following items are included in this section:

A2.2.2.4.1. List of all non-hazardous, hazardous, pathfinder, and safety critical procedures by title and numerical designation with an indication as to which have been designated as hazardous or related to FTS operation.

A2.2.2.4.2. Procedure Descriptions. Procedure descriptions shall include separate listing of tasks so that hazardous tasks within each procedure can be identified.

A2.2.2.4.3. Procedure Task Summaries. Task summaries for each procedure shall include the following information:

A2.2.2.4.3.1. Each separate task.

A2.2.2.4.3.2. Responsible agency.

A2.2.2.4.3.3. Objective.

A2.2.2.4.3.4. Initial and final configuration.

A2.2.2.4.3.5. Equipment and support required.

A2.2.2.4.3.6. Description.

A2.2.2.4.3.7. Hazards and precautions.

A2.2.2.4.3.8. List of approved PPE and detection equipment used in ground operations.

A2.2.2.4.4. Flow Chart Task Summary. A flow chart indicating expected time sequence and location of each individual procedure and task shall be included. Each flow chart block used shall be assigned a maximum of one procedure and include the following information:

A2.2.2.4.4.1. Identifier for each procedure.

A2.2.2.4.4.2. Procedure number.

A2.2.2.4.4.3. Hazardous, non-hazardous, pathfinder or safety critical designation.

A2.2.2.4.4.4. Task summary number(s).

A2.2.2.4.5. Identification of emergency and abort/backout actions.

A2.2.2.4.6. A list of personnel training, certification, and experience requirements for each type of hazardous operation such as ordnance, crane, and propellant operations.

A2.2.2.5. **Off-Site Processing.** The “off-site processing” section shall include the following information:

A2.2.2.5.1. A detailed description of the off-site build-up and transport configuration of the launch vehicle and payload that will be transported to the Range.

A2.2.2.5.2. A description of the tests performed on hazardous and safety critical systems such as rotation of S&A devices, no voltage checks on ordnance systems, pressure checks of pressure and propellant vessels, RF radiation measurements, and preliminary FTS checks.

A2.2.2.6. **Operating and Support Hazard Analysis.** An Operating and Support Hazard Analysis (O&SHA) shall be performed for each procedure and the results summarized in the GOP. This analysis helps identify hazardous procedures, controls, verifications, etc.

A2.2.2.6.1. The O&SHA shall identify and evaluate the safety considerations associated with environments, personnel, procedures, and equipment involved

throughout the operational phase of the program and shall meet the intent of O&SHA requirements in AFSPCMAN 91-710 Volume 1, Attachment 2.

A2.2.2.6.2. O&SHAs shall be conducted for activities such as testing, installation, maintenance, support, transportation, storage, operations, and training.

A2.2.2.6.3. O&SHAs shall coincide with the flow chart task summaries in paragraph **A2.2.2.4**.

A2.2.2.6.4. O&SHAs shall incorporate a worksheet associated with each specific flow block in the flow chart and shall include the following information:

A2.2.2.6.4.1. The general hazard group.

A2.2.2.6.4.2. The specific hazard condition.

A2.2.2.6.4.3. The effect if the hazard is not controlled.

A2.2.2.6.4.4. Hazard control hardware.

A2.2.2.6.4.5. The hazard control procedure.

A2.2.2.6.4.6. Hazard control personnel.

A2.2.2.6.4.7. Reference to the flow block task number.

A2.2.2.7. **Range User Plans.** Range User plans that include, but are not limited to, the following, shall be submitted in or added as appendixes to the GOP as identified in paragraphs **4.5** and **4.6.2**.

A2.2.2.7.1. Range User Training Plan.

A2.2.2.7.2. Accident Notification Plan.

A2.2.2.7.3. Emergency Response Plans for Graphite Epoxy Composite Overwrapped Pressure Vessels.

A2.2.2.8. **Changes.** The “change” section contains a summary of all changes to the latest edition of the GOP. All changes shall be highlighted using change bars or similar means of identification.

Attachment 3

HAZARDOUS AND SAFETY CRITICAL PROCEDURES

A3.1. Introduction.

A3.1.1. **Determination of Hazardous and Safety Critical Procedures.** The Ground Operations Plan (GOP) (**Attachment 2**) is the basic document used to initially determine the classification of a procedure. Specifically all procedure description and task summaries along with the associated Operating & Support Hazard Analyses (O&SHAs) are reviewed. This review validates the Range User's determination of Hazardous, Non-Hazardous, and Safety Critical procedures. Once the classification of Hazardous, Non-Hazardous, and Safety Critical is determined, the procedures are submitted for review and approval as described in the documentation part of this volume. During review of the initial draft procedures, Wing Safety shall determine if Pad Safety notification or attendance shall be required. The review of the draft procedures allows a second opportunity to ensure the classification is appropriate.

A3.1.2. **Purpose.** Hazardous and safety critical procedures provide a detailed, step-by-step description of the manner in which hazardous and safety critical operations will be accomplished. The procedures are the medium from which approval to start any hazardous or safety critical operation is obtained from the ranges.

A3.1.3. **Content.** This attachment contains content preparation instructions for data generated by requirements delineated in this volume.

A3.1.4. **Applicability.** This attachment is applicable to the following:

A3.1.4.1. All launch vehicle, payload, or service contractors performing hazardous or safety critical operations on the ranges.

A3.1.4.2. Construction and management contracts for hazardous facilities.

A3.1.5. **Submittal Process.** The hazardous procedure submittal process is as follows:

A3.1.5.1. One copy of procedures involving hazardous or safety critical operations shall be submitted to Wing Safety and one copy to Pad Safety for review and approval. The Range User shall review, approve, and sign the final procedures to be submitted to Wing Safety for approval.

A3.1.5.2. For new programs, final Pad Safety and Wing Safety comments, reviews, and approvals shall be provided to the Range User 45 calendar days after receipt of the procedure.

A3.1.5.3. For existing programs, final Pad Safety and Wing Safety comments, reviews, and approvals shall be provided to the Range User 30 calendar days after receipt of the procedure.

A3.1.5.4. Final approved, published procedures incorporating Wing Safety comments shall be submitted to Wing Safety at least seven calendar days before the conduct of the operation.

A3.1.6. **Final Approval.** Hazardous and safety critical procedures shall be approved before starting any hazardous or safety critical operations on the ranges.

A3.2. Preparation Instructions.

A3.2.1. **Content.** Hazardous or safety critical procedures shall be written in a logical format with clear instructions as to the tasks to be performed and hazards and precautions involved.

A3.2.2. **Cover Page.**

A3.2.2.1. A cover page with the procedure title and required approval signatures and date shall be provided. The signature page shall contain a block for Wing Safety signature approval.

A3.2.2.2. The words “Draft” or “Preliminary” shall appear on any signed procedure that does not have the required Wing Safety approval.

A3.2.2.3. The cover sheet shall state “Warning: This Procedure Contains Hazardous (or Safety Critical) Operations” and shall be outlined with a border and marked in bold print.

A3.2.2.4. The cover sheet shall indicate revision level.

A3.2.3. **Purpose Section.**

A3.2.3.1. This section shall provide a brief synopsis of all major tasks in each operating procedure.

A3.2.3.2. The synopsis shall include the following information:

A3.2.3.2.1. A brief description of the tasks, operations, tests, or checkouts to be performed.

A3.2.3.2.2. The facility and area where the procedure is to take place.

A3.2.3.2.3. The departure and arrival locations if transportation is required.

A3.2.3.2.4. For launch vehicle and payload tests, when the test is normally performed in relation to launch day (for example, L-5).

A3.2.4. **Identification of Specific Hazards.** The following specific hazards shall be identified in each procedure:

A3.2.4.1. The quantity and hazard classification of ordnance and propellants involved.

A3.2.4.2. The hazardous and non-hazardous configurations of the system before, during, and upon completion of the operation.

A3.2.5. **Safety Precautions.** As applicable, the following precautions shall be incorporated in each procedure at the beginning of the procedure as well as at the applicable step in the body of the procedure:

A3.2.5.1. Warnings.

A3.2.5.2. Cautions.

A3.2.5.3. Note inhibits.

A3.2.5.4. Safety devices.

A3.2.5.5. Control areas.

A3.2.6. **Facility Configuration Inspections.** The procedure shall indicate the specific facility and safety clearance zone control area to be used.

A3.2.6.1. The requirements for the performance of facility configuration inspections shall be incorporated in the procedures.

A3.2.6.2. The facility configuration inspection requirements shall address verification of the following:

A3.2.6.2.1. Facility explosive limits.

A3.2.6.2.2. Facility personnel limits.

A3.2.6.2.3. Posting of fire symbols when ordnance and propellants are moved into or out of a facility.

A3.2.7. **PPE and Emergency Equipment.**

A3.2.7.1. PPE and emergency equipment requirements for each operation shall be incorporated in hazardous procedures.

A3.2.7.2. The PPE and emergency equipment shall address the following:

A3.2.7.2.1. PPE requirements according to the manufacturer model number, MIL-SPEC, or standard for compliance.

A3.2.7.2.2. The occasions for the use of PPE.

A3.2.7.2.3. Types of emergency equipment required.

A3.2.7.2.4. Location of the emergency equipment during the operation.

A3.2.7.2.5. The number of emergency equipment units required. No substitution or configuration alteration of PPE shall be allowed without specific Wing Safety approval.

A3.2.8. **Pre-Operational Checklist of Required Tools and Equipment.**

A3.2.8.1. A pre-operational checklist of all tools and equipment required for safe operations shall be incorporated in the procedures.

A3.2.8.2. For safety critical equipment, the following information shall be included:

A3.2.8.2.1. Manufacturer, model, and serial number.

A3.2.8.2.2. Location of the equipment during the operation.

A3.2.8.2.3. The number of units required.

A3.2.8.2.4. The required monitoring devices and their alarm settings.

A3.2.8.2.5. Proof test requirements.

A3.2.8.2.6. Nondestructive examination requirements.

A3.2.8.2.7. Calibration requirements.

A3.2.9. **Support Personnel Requirements.**

A3.2.9.1. Range User and range support personnel requirements such as Pad Safety, Fire, Medical, and Security/HOS personnel shall be incorporated in the procedures. In a multi-task procedure, the times these support personnel are needed shall be stipulated.

A3.2.9.2. The following support personnel requirements shall be addressed:

A3.2.9.2.1. The hazardous periods when personnel limits shall be enforced.

A3.2.9.2.2. The minimum essential personnel by functional title and number required.

A3.2.9.2.3. The Pad Safety notification in all cases. Pad Safety presence and concurrence is required before beginning all hazardous operations unless determined otherwise by Wing Safety.

A3.2.9.2.4. Special training, certifications, or experience requirements.

A3.2.10. **References to Applicable Documents.**

A3.2.10.1. All applicable documents, drawings, and specifications shall be referenced in the procedures.

A3.2.10.2. If a specific operations safety plan or other safety plans apply to the procedure, they shall be listed in the procedure reference section.

A3.2.10.3. AFSPCMAN 91-710 shall be listed in the procedures.

A3.2.10.4. Procedures shall not use excessive second tier references. **Note**: Use of excessive second tier references means to incorporate references in such volume that the meaning is lost and use of the procedure becomes confusing, unnecessarily complex, or irrelevant.

A3.2.11. **CCAFS Cape Support and WR Range Scheduling Notification.** Notification of CCAFS Cape Support (321-853-5211) and Range Scheduling (321-853-5941) on the ER and Range Scheduling (805-606-8825) on the WR 24 hours before the planned start of the operation shall be incorporated in the procedures.

A3.2.12. **Pre-Task Briefing.**

A3.2.12.1. A step for the conduct of a pre-task briefing shall be incorporated in the procedures.

A3.2.12.2. The following topics shall be addressed:

A3.2.12.2.1. Operational hazards.

A3.2.12.2.2. Precautions.

A3.2.12.2.3. Emergency actions.

A3.2.12.2.4. Critical task items.

A3.2.12.2.5. Procedure flow.

A3.2.12.2.6. Operational discipline.

A3.2.12.2.7. Communication discipline.

A3.2.12.3. Specification that the briefing shall be repeated if a shift change is required.

A3.2.13. **Step-by-Step Directions.**

A3.2.13.1. Step-by-step directions, written in clear language, with sufficient detail to allow a qualified technician or mechanic to clearly understand and follow them, shall be incorporated.

A3.2.13.2. The procedure shall contain applicable data sheets, figures, and schematics to document or clarify system parameters and connect points.

A3.2.14. **Identification of Hazardous and Safety Critical Portions of Procedures.**

A3.2.14.1. The beginning and end of a hazardous or safety critical portion of a procedure shall be clearly identified according to the following criteria:

A3.2.14.1.1. A "Warning" shall be used to identify hazards to personnel.

A3.2.14.1.2. A "Caution" shall be used to identify hazards to equipment.

A3.2.14.1.3. A "Note" shall be used to indicate an operating procedure of such importance that it must be emphasized.

A3.2.14.2. The activation of warning lights, PA announcements, and notification to Security/HOS of any controlled areas, if not accomplished as a pre-task item, shall be incorporated.

A3.2.14.3. Safety highlights such as evacuations, safety clearance zones, clearances, activation of aural and visual warnings shall be detailed before the hazardous sequence and in the applicable section of the procedure.

A3.2.15. **Emergency Shutdown and Backout Steps.** Emergency shutdown and backout procedures or steps necessary to safe the system or facility in the event of a mishap, incident, or abort shall be incorporated.

A3.2.16. **Transmittal of Procedures.** Procedures shall be forwarded to Wing Safety with a transmittal letter containing the following information:

A3.2.16.1. Need Date (minimum of 30 calendar days review time required for existing programs; 45 for new programs).

A3.2.16.2. Procedure title and number.

A3.2.16.3. Program identified or other identifier to ensure that the proper Wing Safety point of contact receives the procedure.

A3.2.16.4. Special instructions for such items as review and comment and final copy for filing.

A3.2.16.5. Pertinent information such as "procedure is non-hazardous," "procedure change does not affect the hazardous portion of the procedure nor otherwise have a safety impact," or "all previous comments have been incorporated."

A3.2.16.6. If the procedure has been previously submitted as a draft or with a different revision number, clarification of the extent of the changes.

A3.3. Changes. Changes to previously submitted procedures shall be noted with change bars or a similar method of marking.

Attachment 4

RANGE SAFETY LAUNCH COMMIT CRITERIA

A4.1. Introduction. Range safety launch commit criteria (LCC) are those criteria associated with launch day parameters that must be met prior to final SW/SE approval for launch. These criteria ensure public, launch site, and launch complex safety. They include launch vehicle, range, and environmental factors.

A4.1.1. **Purpose.** This attachment provides Range Users with general, and, where possible, specific information regarding LCC. Knowledge of this criteria may help Range Users to better understand and plan for potential Wing Safety holds or scrubs as a result of related violations during the launch countdown.

A4.1.2. **Content.** Descriptions of each LCC are included in this attachment. Where possible, the exact criteria used during the countdown are provided. General criteria are provided for cases in which the criteria are too complex to address in this publication and/or where the criteria is in a state of flux. Wing Safety offices of primary responsibility (OPR) and referenced documents are provided as sources of additional information.

A4.1.3. **Applicability.** All LCC are not applicable to all launch vehicles. The applicability of each LCC is identified in the individual descriptions. Additional specific LCC may be provided as part of the range safety operational requirements (RSOR) or operations supplement to the RSOR for each individual mission. **Note**: Launch commit criteria do not apply to operational weapon systems (e.g., missile defense interceptors) based at the ranges.

A4.2. Range Safety Launch Commit Criteria.

A4.2.1. **Flight Safety Systems.** Flight safety systems are those ground and airborne systems required to monitor, track, aid decision making, and, if necessary, destroy errant launch vehicles in flight.

A4.2.1.1. **Ground Range Safety Systems.**

A4.2.1.1.1. **General Description.** Ground Range Safety Systems include such systems as the command terminate system, range tracking system (RTS), telemetry data transmitting system (TDTS), range safety display systems (RSD), and all other associated ground-based systems necessary to monitor, track, aid decision making, and destroy an errant launch vehicle.

A4.2.1.1.2. **Applicability.** All launch vehicle missions using a ground-initiated command destruct flight termination system (FTS) require certain ground range safety system assets to be operational prior to launch. The launch vehicle configuration, launch azimuth, and other factors drive the selection of necessary ground safety system assets. **Note**: For an autonomous flight safety system, certain ground assets may also be required, depending on the specific implementation choices that could affect requirements for command receivers and command destruct sites. Tailor the below launch commit criteria as applicable in those situations.

A4.2.1.1.3. **Ground Range Safety System Launch Commit Criteria.**

A4.2.1.1.3.1. Range tracking systems include radars, optics, telemetered inertial

guidance downlinks, and Global Positioning System (GPS) metric tracking.

A4.2.1.1.3.1.1. Two adequate and independent tracking sources shall be available throughout powered flight.

A4.2.1.1.3.1.1.1. "Adequate" is defined by error statistics for each source.

A4.2.1.1.3.1.1.2. "Independent" is defined as having no common components or systems between the vehicle and the front-end computers in the operations control center such as to create a common failure mode.

A4.2.1.1.3.1.2. Tracking sources shall be tested prior to launch to ensure requirements for accuracy and data integrity such as good communication with the operations control center.

A4.2.1.1.3.2. The Command Destruct System (CDS) has dual transmitter sites connected to central command in the operations control center. The system is capable of operation in both secure and non-secure modes.

A4.2.1.1.3.2.1. A dual command site (two transmitters connected by an automatic failover control system) and two command data links shall be available throughout powered flight.

A4.2.1.1.3.2.2. Using test codes, closed loop testing shall be performed between command central and each site prior to launch to ensure proper performance of the system.

A4.2.1.1.3.2.3. Using flight codes, closed loop testing shall be performed between command central and the launch area command site prior to launch to ensure code integrity.

A4.2.1.1.3.2.4. Using test codes, open loop testing shall be performed between command central, via the launch area command site, to the launch vehicle before launch to ensure total system integrity.

A4.2.1.1.3.2.5. System testing shall include the use of both the Flight Termination Unit (FTU) and the Range Safety control and display (RASCAD) console.

A4.2.1.1.3.2.6. Using test codes, open loop testing shall be performed between command central, via each command site, to the command destruct independent test sets (CDITS) prior to launch to quantitatively verify proper message, code, and radio frequency parameters.

A4.2.1.1.3.3. Computer and data communications systems, including RSD systems, collect and process data from the tracking sources. They calculate vehicle state vector information and predict the vacuum impact point of a vehicle in real time. In addition, the vehicle positional information generated in the RSD system is used to point command terminate antennas at the vehicle and provide the MFCO with graphic displays of vehicle position, velocity, and impact point overlaid on a geographic representation of the flight.

A4.2.1.1.3.3.1. Using end-to-end playback of theoretical data, the proper function of all computer and data communication systems shall be verified prior

to launch.

A4.2.1.1.3.3.2. The data processing and display (RTP/RSD) systems and their associated peripheral support equipment are configured in two independent strings connected with an automatic failover system. A minimum of two strings shall function correctly before allowing a vehicle to launch.

A4.2.1.1.4. **Offices of Primary Responsibility.**

A4.2.1.1.4.1. The Launch/Reentry Safety Sections of the respective Wing Safety Offices are the OPRs and the Wing Range Operations Squadron is the Office of Corollary Responsibility (OCR) for determining ground safety systems launch commit criteria.

A4.2.1.1.4.2. The Launch/Reentry Safety Sections of the respective Wing Safety Offices are the OPRs for the RSOR, which the Chief of Safety approves.

A4.2.1.1.4.3. The Launch/Reentry Safety Sections of the respective Wing Safety Offices are the OPRs and the Wing Range Operations Squadron is the OCR for the operations supplement, which the Chief of Safety approves.

A4.2.1.1.5. **Reference Documents.** Vehicle-specific ground safety systems launch commit criteria shall be documented in the RSOR. Mission-specific modifications to the RSOR are published for each operation in the operations supplement.

A4.2.1.2. **Airborne Flight Safety Systems.**

A4.2.1.2.1. **General Description.** Airborne FSSs include the FTS and the airborne RTS.

A4.2.1.2.2. **Airborne FSS.** An airborne FSS is required for all reentry vehicles and powered flight stages of a launch vehicle IAW the requirements of AFSPCMAN 91-710 Volume 2. The need for an airborne FSS for all upper stages, payloads, and/or spacecraft capable of powered flight, or reentry vehicles is determined as part of the flight plan approval process addressed in AFSPCMAN 91-710 Volume 2. An RTS is required for all launch vehicles and reentry vehicles per AFSPCMAN 91-710 Volume 2.

A4.2.1.2.3. **Airborne FSS Launch Commit Criteria.**

A4.2.1.2.3.1. The Pad Safety Console (PSC) (ER) and the Flight Safety Project Officer Console (FSPOC) (WR) shall be used to monitor the status of the airborne FTS prior to launch. **Note**: For an autonomous flight safety system, certain ground assets may also be required, depending on the specific implementation choices that could affect requirements for command receivers and command destruct sites. Tailor the below launch commit criteria as applicable in those situations.

A4.2.1.2.3.1.1. Final airborne FTS open-loop testing shall be performed while on airborne power just before launch.

A4.2.1.2.3.1.2. All components of the airborne FTS shall be operating within expected limits prior to launch.

A4.2.1.2.3.1.3. The FTS shall be armed prior to launch.

A4.2.1.2.3.2. Radar installations and mobile frequency measurement vans are used to monitor the status of the airborne RTS. The airborne RTS shall be operating within expected limits before launch.

A4.2.1.2.3.3. If providing tracking data, the airborne TDTS shall be operating within the expected limits before proceeding with the launch.

A4.2.1.2.3.4. A launch hold or launch scrub shall be implemented if the above criteria are not met.

A4.2.1.2.4. **Offices of Primary Responsibility.**

A4.2.1.2.4.1. 30 SW/SEA and 45 SW/SEA are the OPRs for airborne FTS launch commit criteria.

A4.2.1.2.4.2. 30 SW/SEA and 45 SW/SEA are the OPRs for airborne RTS launch commit criteria. The Wing Range Operations Squadron is OCR for airborne RTS launch commit criteria.

A4.2.1.2.5. **Reference Documents.**

A4.2.1.2.5.1. Operating characteristics of the PSC and FSPOC are required as part of the airborne Flight Termination System Report (FTSR) IAW the requirements of AFSPCMAN 91-710 Volume 4, Chapter 9.

A4.2.1.2.5.2. Vehicle-specific airborne RTS launch commit criteria shall be documented in the RSOR. Mission-specific modifications to the RSOR shall be published in the operations supplement to the RSOR for each operation.

A4.2.2. **Blast Overpressure.**

A4.2.2.1. **General Description.** The distance focusing overpressure (DFO) model addresses intermediate hazardous range effects of a shock wave from an inadvertent detonation, such as from a launch vehicle malfunction, impact, or destruction. Near-in areas of overpressure above one pound per square inch (psi) are evacuated of personnel and are not considered in the assessment. At far-out distances, with overpressures of less than 0.1 psi, there are relatively small hazards. It is the intermediate distance with overpressures of 0.1 to 0.5 psi that are of concern. The area encompassing overpressures in this range varies considerably with local meteorological conditions.

A4.2.2.2. **Applicability.** This launch commit criteria is generally applicable to large launch vehicles with large amounts of propellants, solid rocket motor launch vehicles with high energy propellants, and launch vehicles using launch complexes near the borders of general population.

A4.2.2.3. **DFO Launch Commit Criteria.** If the expected casualties of a potential blast overpressure exceed those limits defined in AFSPCMAN 91-710 Volume 1, Wing Safety recommends the range go “red” until either the risk to the affected population can be mitigated or another software model run can be made with updated meteorological data.

A4.2.2.4. **Offices of Primary Responsibility.** 30 SW/SEL and 45 SW/SEL are the OPRs for the DFO risk assessment model and launch commit criteria associated with an overpressure hazard.

A4.2.2.5. **Reference Documents.** Mission-specific blast launch commit criteria shall be addressed in the RSOR and/or Ops Supplement.

A4.2.3. **Launch Collision Avoidance.**

A4.2.3.1. **General Description.** A launch collision avoidance (COLA) analysis is used in the minus count to screen launched objects (e.g., booster segments, payloads, jettisoned components, debris) against all catalogued objects.

A4.2.3.2. **Applicability.** All launched objects with an altitude capability equal to or greater than 150 km.

A4.2.3.3. **Collision Avoidance Launch Commit Criteria.** Launch COLA criteria is specified in AFI 91-202.

A4.2.3.4. **Offices of Primary Responsibility.** 30 SW/SEL and 45 SW/SEL are the OPRs for determining COLA launch commit criteria. The 18th Space Control Squadron (18 SPCS) conducts conjunction assessments.

A4.2.3.5. **Reference Documents.** Using trajectory information provided by the Range User prior to launch, via the Form 22, 18 SPCS screens the launch vehicle against the space catalog and provides conjunction information for each associated launch time. Mission-specific collision avoidance/launch hold times shall be documented by 45 SW/SEL and 30 SW/SEL for the Ops Group and Range User.

A4.2.4. **Debris Hazard.**

A4.2.4.1. **General Description.** A debris risk assessment model is used to compute the estimate of casualty to personnel supporting the operation and to the general public due to debris from a catastrophic launch abort during flight. The debris risk assessment model incorporates the latest available atmospheric and weather data as well as vehicle breakup, malfunction turn, trajectory, and failure rate data.

A4.2.4.2. **Applicability.** In general, the launch commit criteria is applicable to all launch vehicles using a flight safety system (FSS) and/or active guidance systems. Some larger rail-launched or unguided vehicles may also be affected.

A4.2.4.3. **Debris Hazard Launch Commit Criteria.** If the expected casualties exceed those limits defined in AFSPCMAN 91-710 Volume 1, Wing Safety recommends the range go “red” until another debris risk assessment model run can be made with updated data or until mitigating actions can be implemented.

A4.2.4.4. **Office of Primary Responsibility.** 30 SW/SEL and 45 SW/SEL are the OPRs for debris risk assessment models and associated launch commit criteria.

A4.2.4.5. **Reference Documents.** Mission-specific debris hazard launch commit criteria shall be addressed in the RSOR and/or Ops Supplement.

A4.2.5. **Natural and Triggered Lightning.**

A4.2.5.1. **General Description.** Both natural and triggered lightning can cause launch vehicle malfunction and/or destruction. Triggered lightning is the phenomena associated with launch vehicles affecting the atmosphere during flight so that, under certain meteorological conditions, lightning is triggered and attracted to the launch vehicle.

A4.2.5.2. **Background.** The natural and triggered lightning launch commit criteria are developed cooperatively by the USAF, NASA, and FAA for United States launches. The criteria are based upon publicly available research, as well as analysis led by the joint NASA/USAF Lightning Advisory Panel (LAP), consisting of world-wide recognized experts in atmospheric electricity and associated disciplines. The criteria in whole or part are used across the globe due to the rigor of the documented criteria and associated rationale.

A4.2.5.3. **Applicability.** The Launch Weather Team (LWT) shall have clear and convincing evidence that the following hazard avoidance criteria are not violated. Even when these criteria are not violated, if any other hazardous condition exists, the LWT will report the threat to the appropriate authority. All launch vehicles are subject to these launch commit criteria.

A4.2.5.4. **Natural and Triggered Lightning Launch Commit Criteria.** The current criteria, along with associated terms and definitions, are documented in NASA Technical Standard 4010 (NASA-STD-4010), *NASA Standard for Lightning Launch Commit Criteria for Space Flight*. This document can be accessed online at **https://standards.nasa.gov/standard/nasa/nasa-std-4010**.

A4.2.5.5. **Offices of Primary Responsibility.** 30th Operational Support Squadron (30 OSS) and 45th Weather Squadron (45 WS) are the OPRs for natural and triggered lightning launch commit criteria. 30 SW/SE and 45 SW/SE are the OCRs. Due to review and publishing cycles, recent changes to the lightning launch commit criteria may not be reflected in the most current NASA-STD-4010. Thus, the applicable launch/range weather support organization (i.e., 30 OSS or 45 WS) will contact range users when any significant changes are made to criteria not yet published in the current NASA-STD-4010.

A4.2.5.6. **Reference Documents.** Additional or different mission specific natural and triggered lightning launch commit criteria shall be documented in the RSOR and/or Ops Supplement.

A4.2.6. **Toxic Dispersions.**

A4.2.6.1. **General Description.** A variety of predictive models and analytical techniques are used to ensure that the public and launch area personnel are not exposed to toxic chemicals in concentrations that exceed applicable threshold limits. Key considerations include, but are not limited to, the specific commodities loaded and their quantity; potential agents resulting from mixing and/ or reactions; nature or mechanism of release; and weather parameters such as wind speed, wind direction, temperature, temperature gradient, inversion layer, surface reflection coefficient, exposure response functions, and cloud cover as well as the uncertainty of these parameters.

A4.2.6.2. **Applicability.** All launch vehicles, including payloads, with potentially hazardous chemicals are subject to this toxic launch commit criteria. Range Users shall identify the specific toxic/hazardous commodities and the quantity that will be contained on each launch vehicle/payload mission, and shall provide data in compliance with the requirements of AFSPCMAN 91-710 Volume 2.

A4.2.6.3. **Toxic Launch Commit Criteria.** Acceptable exposure limits for various commodities are governed by a number of standards, statutes, and specifications which are

subject to frequent revision based on controlled studies, real-world events, and other discoveries. Additionally, commodity loads also vary among launch vehicle classes and there are differences between variants within the same class. If the expectation of casualty of an exposure to a toxic commodity exceeds the limits defined in AFSPCMAN 91-710 Volume 1, Wing Safety recommends that the range go "red" until either the risk to the affected population can be mitigated or another software model run can be made with updated meteorological data. For toxic launch commit criteria see AFSPCMAN 91-710 Volume 1 and for guidance regarding a specific commodity or set of commodities in the case of a particular launch vehicle, contact the 45 SW/SELR (Launch Risk Analysis). At the WR, the 30 SWI 91-106 defines the exposure criteria, unit support requirements, actions required for hot and cold spill potential Hazard Zones as well as other requirements.

A4.2.6.4. **Offices of Primary Responsibility.** 30 SW/SEL and 45 SW/SEL are the OPRs for toxic dispersion launch commit criteria.

A4.2.6.5. **Reference Documents.** Mission-specific toxic launch commit criteria shall be addressed in the RSOR and/or Ops Supplement.

A4.2.7. **Safety Clearance Zones.** Safety Clearance Zones are restricted areas designated for day-to-day prelaunch processing and launch operations to protect the public, launch area, and launch complex personnel. These zones are established for each launch vehicle and/or payload at specific processing facilities to include launch complexes. Safety Clearance Zones include Hazardous Clear Areas and Hazardous Launch Areas.

A4.2.7.1. **Hazardous Clear Areas.**

A4.2.7.1.1. **General Description.** Hazardous Clear Areas are Safety Clearance Zones for ground processing that are defined in the OSP for each operating facility. Hazardous Clear Areas include Blast Danger Areas (BDA), Control Area Clears, and Toxic Hazard Corridor (THC) (ER) and Toxic Hazard Zone (WR).

A4.2.7.1.2. **Applicability.** All launch vehicles and, if necessary, associated payloads shall be evaluated and hazardous clear areas determined.

A4.2.7.1.3. **Hazardous Clear Areas Launch Commit Criteria.**

A4.2.7.1.3.1. Blast Danger Area. Clearance prior to establishment of a major explosive hazard such as vehicle fuel/oxidizer load and pressurization. This is the area subject to fragment and direct overpressure resulting from the explosion of the booster/payload.

A4.2.7.1.3.2. Control Area Clear. Clearance of defined areas to protect personnel from hazardous operations.

A4.2.7.1.3.3. Toxic Hazard Corridor/Zone. Clearance area of a sector in which toxic material may exceed predetermined allowable concentration levels.

A4.2.7.2. **Hazardous Launch Areas.**

A4.2.7.2.1. **General Description.** Hazardous Launch Areas are Safety Clearance Zones used during launch operations and include the flight caution area (FCA), flight hazard area (FHA), and the Impact Limit Lines (ILLs).

A4.2.7.2.2. **Applicability.** All launch vehicles and, if necessary, associated payloads, shall be evaluated and hazardous launch areas determined.

A4.2.7.2.3. **Hazardous Launch Area Launch Commit Criteria.**

A4.2.7.2.3.1. FHA. Only Wing Safety approved launch-essential personnel are permitted in this area during a launch. (See SPFCMAN 91-710 Volume 7 for the definition of flight hazard area.)

A4.2.7.2.3.2. FCA. Only Wing Safety approved launch-essential personnel are permitted in this area during launch. (See SPFCMAN 91-710 Volume 7 for a definition of flight caution area.)

A4.2.7.2.3.3. ILL. Wing Safety approved launch-essential and neighboring operations personnel are permitted within ILLs during a launch. Non-essential personnel, with SW Commander approval, may be permitted in this area during a launch; however, the collective risk shall not exceed acceptable standards for the general public. (See SPFCMAN 91-710 Volume 7 for definitions of impact limit line, launch-essential personnel, and neighboring operations personnel.)

A4.2.8. **Launch/Reentry Area Air and Sea Surveillance.**

A4.2.8.1. **General Description.** Areas to be cleared of boats, ships and aircraft are defined by flight safety analysis, based on probability contours and/or Toxic Hazard Zones, including known impact areas of jettisoned stages/bodies and debris resulting from malfunction scenarios plus the areas and altitudes in which toxic hazards will exist. These areas are published in Notice to Airmen (NOTAM) and Notice to Mariners (NTM or NOTMAR). Only those areas which can cause a violation of AFSPCMAN 91-710 Volume 1 risk criteria are surveyed for intruders on launch/reentry day.

A4.2.8.2. **Applicability.** These criteria are applicable to all CCAFS/KSC pad launches and reentries, select offshore Navy launches, and all 30 SW launch operations.

A4.2.8.3. **Launch/Reentry Area Air and Sea Surveillance Launch Commit Criteria.** The risk to personnel on identified air and sea platforms shall be addressed in the determination of compliance with criteria in AFSPCMAN 91-710 Volume 1.

A4.2.8.4. **Offices of Primary Responsibility.** 30 SW/SEL and 45 SW/SEL are the OPRs for performing analyses that establish hazardous launch areas for air and sea surveillance, and for determining with the Range User, assets that are mandatory for sea surveillance. The Area Surveillance Officer (ASO)/Surveillance Control Officer (SCO) is the OPR for operationally implementing launch area air and sea surveillance requirements, unless performed by the Range User.

A4.2.9. **Jettisoned Bodies Impacting Land in Launch Area.**

A4.2.9.1. **General Description.** Jettisoned components shall be prohibited from impacting on a landmass. For certain launch vehicles, the possibility exists for jettisoned bodies such as nozzle closures to impact in the launch area near occupied facilities or resources requiring protection. This is allowed in these cases when the risks associated are mitigated or minimized. Hit probability contours are created and used in conjunction with launch day impact prediction runs to determine possible threat near the predicted impact location.

A4.2.9.2. **Applicability.** All vehicles jettisoning components in the launch area with the potential to impact land.

A4.2.9.3. **Jettisoned Bodies Launch Commit Criteria.** Launch day impact prediction runs are made and the associated probability contours or impact dispersions are overlaid with the launch areas. A launch hazard may result in a launch hold or scrub condition.

A4.2.9.4. **Offices of Primary Responsibility.** 30 SW/SEL and 45 SW/SEL are the OPRs for performing analysis in support of jettisoned bodies impacting land.